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Cameron Jae Geertsema

2003

**EMERGING TRENDS OF THE OWNER-CONTRACTOR
RELATIONSHIP FOR CAPITAL FACILITY PROJECTS:
*FROM THE CONTRACTOR PERSPECTIVE***

by

Cameron Jae Geertsema, B.S.

Thesis

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

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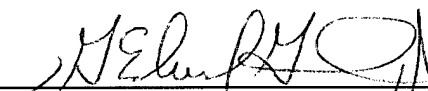
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RELATIONSHIP FOR CAPITAL FACILITY PROJECTS:
*FROM THE CONTRACTOR PERSPECTIVE***

**Approved by
Supervising Committee:**



Supervisor: G. Edward Gibson, Jr.



John D. Borcharding

Dedication

*To my wife, Jill, my daughter, Julia,
and my parents with love and appreciation*

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Date Submitted August 1, 2003

Abstract

EMERGING TRENDS OF THE OWNER-CONTRACTOR RELATIONSHIP FOR CAPITAL FACILITY PROJECTS: *FROM THE CONTRACTOR PERSPECTIVE*

Cameron Jae Geertsema, M.S.E

The University of Texas at Austin, 2003

Supervisor: G. Edward Gibson, Jr.

This thesis analyzes and documents the emerging trends and the changing nature of the contractor-owner relationship for capital facility projects from the contractor perspective. Specifically, this document will focus on how the outcome of capital facility projects are affected by human resources practices, and the management principles and practices of the contractor-owner relationship during performance of capital facility projects. Additionally, information will be provided to highlight the trends of how both collaborative and non-collaborative relationships impact the successful completion of a capital facility project. The intended purpose of this research is to provide the contractor-owner organizations with current trends and possible recommendations for future decision making which will help to enhance the performance of firms as they work more closely with one another.

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Chapter 1: Introduction

1.1 PURPOSE

The purpose of this thesis is to explore at emerging trends within the owner-contractor working relationship and document the changing nature of the owner-contractor relationship towards the successful completion of capital facility projects. This is deemed the first step towards trying to understand the very dynamic nature of owner-contractor relationship and should aid in developing a set of industry specific management philosophies and principals for contractors. Ultimately, this should allow contractors, “to cope with the wider distribution of power and knowledge in this new era of partnership enterprise (Deering and Murphy, 1998, 20).”

Today’s owners have adapted their engineering and management principles to reflect the changing environment of the construction industry. The owners, driven by changes in the global business environment have downsized capital facility engineering capabilities and outsourced capital project functions in an effort to leverage contractor manpower and expertise, reduce costs, and improve their competitive advantage. The overall impact of this shift in owner-contractor organizational functions in design, construction management, internal core management functions, and procurement of goods and services has had a significant impact on the contractors that service this industry.

1.2 SCOPE

The scope of this research is interested in identifying the organizational changes in the owner-contractor link caused by the increased use of business relationship networks to manage this “partnership,” and the impact of these network business relationships on the contractor organizations in terms of structure, function, performance, and human resources.

In addition to the parallel initiatives of the Owner-Contractor Organizational Changes study (from the Owner’s Perspective), the Owner-Contractor Organizational Changes study (from the Contractor’s Perspective) was developed. Contractor’s Study Phase I was conducted in November of 1998 and was the subject of CCIS report No. 11. Subsequently, the follow on research, Contractor’s Study Phase II, which are a of the findings from Phase I, are the subject of this thesis and will be discussed in greater detail in Chapter Two.

This study’s objectives include: identifying the nature of the changes in the owner-contractor relationship, understanding what practices contribute to the effectiveness of the relationship, and whether the nature of the relationship effects the tangible outcomes of a project and its human resource requirements.

1.3 Hypotheses

The primary purpose of this research is to build on previous research in the areas of organizational change, business relationship development, network management, and organizational learning to develop construction industry specific principals and practices to enhance the performance of contractor firms as they transition into "partnership enterprises." Consequently, the following hypotheses are given.

1.3.1 Organizational Change

Organizational Change - The Contractor Phase I Study noted that among the individuals interviewed, the single, most defining change in the owner-contractor organizational structure over the last five years has been the explosive increase in the outsourcing of design, engineering and construction management services by owner firms (Gibson and Ryan 2000). This increase in outsourcing by owner firms has been accompanied by changes in types of services requested and a change in the classification of these services from a custom to a commodity product. All of the firms in the Phase I Contractor Study reported that they were involved in some form of owner-contractor collaborative relationship. Many noted that these relationships have become the major source of their business. Based on the general business and industry specific literature, this is representative of a transition in the marketplace to relational enterprises.

H1: The outsourcing of design, engineering and construction management services by owner organizations has caused the relationship structure between owners and contractors to change significantly. The inability of the work processes and resources needed to manage these changes to keep pace with the changes in the relationship structure has created a secondary inter-organizational boundary that defines the owner-contractor work relationship continuum.

1.3.2 Business Relationship Development

The Phase II Owner Study found that the owner-contractor relationship appears to have many purposes, not all of which are fully recognized by owners. One of the things that makes managing the owner-contractor relationship difficult is that the kinds of leverage the owner firm expects are often not made explicit and may not even be agreed upon within the owner firm. Communication difficulties between the owner and contractor are the most commonly cited problem in the owner-contractor relationship (Davis-Blake et al. 1999). While owners and contractors use a wide variety of formal and informal coordinating mechanisms, it appears that existing coordination mechanisms are not sufficient to meet communication needs (Gibson et al. 1998). Although increasing dependence of owners on contractors means that good communication between owners and contractors is more critical than ever, there appears to be little systematic attention by owner firms to designing coordination mechanisms that

fully meet their communication needs. Monitoring and evaluating contractor performance is another area where work structures have not kept pace with the changing nature of the owner-contractor relationship. Although owners have at least some metrics for project performance, few instances were found where owners had clear metrics that could be used to assess the performance of relationships.

The Phase I Contractor Study found similar issues with the owner-contractor relationship from the contractors' perspective (Gibson and Ryan 2000). All contractor firms interviewed in the Phase I Contractor Study reported formal processes for coordinating, monitoring and measuring *project* performance. Formal programs for coordinating, monitoring and measuring the performance of their strategic owner-contractor *relationships* were rarely reported. The contractor community also cited issues with the quality, frequency and timeliness of communications. Lack of familiarity with the project process by the owner, issues of staffing compatibility and organizational objective alignment further complicate the contractors' abilities to service their clients. Each of these items can be a unique problem within the context of a collaborative relationship. The number of relationship issues and their existence as issues for both parties indicates symptoms of a larger problem.

H2: Contractors and owners have different perceptions of the nature of collaborative relationships. Since neither party understands the intricacies of why

a collaborative relationship is successful, they are unable to manage their collaborative relationships. They default to managing the relationship outcomes.

1.3.3 Network Management

The Phase II Owner Study reported that many owner personnel saw goal conflict as a symptom of difficulty with the contractor or with the owner-contractor relationship. In fact, goal conflict may not be a symptom of difficulty but may instead be a natural outgrowth of the fact that owners and contractors have different business objectives (Davis-Blake et al. 1999).

The Phase II Owner Study also found that owner personnel are unanimous in their view that changing owner-contractor relationships require owner personnel to have new skills. It is fairly widely recognized in owner firms that the skill sets required to manage and work on projects from the owner's side has changed dramatically (e.g., more "soft" skills are important; deep technical knowledge is less important). In order to work effectively in an environment where contractors are used extensively, owner personnel must possess a variety of skills. Although the skill set required of owner personnel has changed radically, owner firms have invested relatively little systematic effort into methods for ensuring that their personnel have the required skill sets. A major shift from technical skills to communication and interpersonal skills within the competency requirements for contractor project personnel was also noted in the Phase I Contractor Study (Gibson and Ryan 2000). Contractor personnel, regardless of

their position, have to “wear so many hats” and interface with so many different types of people that their primary skills have to be the ones that allow them to interface with the myriad of people who now compose the typical project team.

H3: Contractor organizations have not provided their personnel with the human resource requirements or organizational structure required to transition to the network management of business relationships.

1.3.4 Organizational Learning

Although owners desire to learn from contractors and cite increased learning as an important benefit of alliance and preferred provider relationships, the Phase II Owner Study reported that owner firms still do not have systematic structures for assessing and documenting their learning from contractors (Gibson and Ryan 2000). The Phase I Contractor Study noted a similar trend in the contractor community. Contractor firms are currently much more adept at converting individual *project* knowledge to organizational *project* knowledge than they are at converting individual owner-contractor *relationship* knowledge to organizational or inter-organizational *relationship* knowledge (Gibson and Ryan 2000).

H4: The contractor community is still employing the "traditional" organization knowledge creation process but operating in an "imaginary organization" environment.

1.4 Organization of Thesis

Great attempts were made to organize this thesis into a logical and easy to follow document. Chapter Two will provide background information for this thesis as well as outline and discuss previous research studies which support this document. Chapter Three will provide information on how the study was organized, how the questionnaires for the human resource managers, management, and project managers of each company were developed, how the participants were selected, and how the study was executed. Chapters Four and Five will provide an analysis of the surveys for each of the three subject groups and discuss relationships existing between one another and those of the Owner Organizational Changes Study. In addition, all information will be discussed from a contractor's perspective and, where specified in the questionnaire, will involve whether a collaborative or non-collaborative relationship had any statistical significance on the outcome of the results. Chapter Six will present the conclusions and any recommendations for future research.

Chapter 2: Background

This chapter presents background information regarding previous research related studies from the Center for Construction Industry Studies (CCIS), specifically CCIS Report No. 11 (Gibson and Ryan 2000), on other Owner Organization related documents from CCIS, and from an unpublished manuscript created and researched by Mrs. Donna Jean Ryan-Rose (Ryan 2002).

2.1 CENTER FOR CONSTRUCTION INDUSTRY STUDIES (CCIS)

The CCIS organization is a research center at the University of Texas at Austin's Construction Engineering and Project Management Program (CEPM). CCIS was initiated in 1996 with multi-year support from the Alfred P. Sloan Foundation and the Construction Industry Institute (CII). The center was created to perform multi-disciplinary, long-range studies addressing construction industry challenges in order to complement the traditionally short-term research process employed by CII and others.

CCIS initially identified and pursued research in four areas of pressing interest for the construction industry. These four thrust areas have been identified as: Owner-contractor Work Study, Fully Integrated & Automated Project Processes (FIAPP), and Construction Work Force Issues and Technology.

The Owner-Contractor Work Study initiative is the direct response of CCIS to a major strategic issue identified by CII. Specifically, the nationwide

downsizing of capital facility engineering capabilities has resulted in owner organizations outsourcing capital project functions in an effort to leverage contractor manpower and expertise (CCIS Website).

However, it is within this Owner-Contractor Work Study initiative that the basis of this document is found. Two such studies, the Owner Organizational Changes Study and the Contractor Organizational Changes Study are within the Owner-contractor Work Study group and are considered to both be very important and parallel initiatives. The later of the two initiatives is the subject of this thesis and will be discussed in detail from the contractor perspective.

2.1.1 Owner Organizational Changes Study

The Owner Organizational Changes Study was the first initiative launched by CCIS to develop an understanding of the issues related to the changes in owner organizations occurring in the industry. Its focus was investigating the following questions from an owner perspective: What constitutes a successful owner-contractor relationship? What is "relationship success" and how can it be measured? How can owners and contractors develop appropriate skills in their engineering and managerial workforce? And how do owners ensure appropriate knowledge transfer to contractors? (Davis-Blake et al. 1999)

The owner study team completed and published the results of two study phases. The findings of the Owner Phase I Study were published in March 1998

(Gibson et al. 1998). The Owner Phase II Study findings were published in April 1999 (Davis-Blake et al. 1999).

2.1.2 Contractor Organizational Changes Study

The Contractor Organizational Changes Study was initiated in November 1998. This investigation assesses the changing nature of the owner-contractor relationship from the contractor perspective. Its objectives include: identifying the nature of the changes in the relationship, understanding what practices contribute to the effectiveness of the relationship, and whether the nature of the relationship affects the tangible outcomes of a project and its human resource requirements.

To date, the study team has completed one phase, Contractor Phase I Study, published in April 2000 (Gibson and Ryan 2000). Contractor Phase II findings are the subject of this thesis, and research methodology was derived from the findings and guidance of the Phase I Study and the Owner Organizational Studies.

2.1.3 Outsourcing Trends (Benchmarking) and Demographics

Benchmarks of demographics and owner outsourcing were the subject of several studies, together, these studies baseline the current status of many industry practices (Davis-Blake et al. 2001) and (Gibson et al. 2001).

One study by Davis-Blake et al., (2001) analyzed data received from a survey of Construction Industry Institute (CII) member firms concerning project engineering professional demographic data. It was conducted with the help of CII from October 2000 to April 2001. For the purposes of this research only the important findings pertaining to contractor firms will be discussed. Motivation for such a report was generated as a result of working closely with the construction industry and it became very apparent that serious problems may exist within the construction industry's professional engineering workforce.

One problem is the bimodal age and experience profile of project engineering employees within *both owner and contractor firms*—i.e., their staffs are constituted primarily of highly experienced professionals and a few new recruits, with very few employees in the middle range of age and experience. The gap occurs in the 30 to 45 year age group and correspondingly in the 10 to 25 year experience level. Every organization that our team has investigated (over a dozen in the past year) has a significant gap in the age profile of its project engineering staff. On the owner side, the strategy for dealing with this gap has been to outsource functions as senior staff members retire. On the contractor side, there is often little strategy; contractor staffs are being asked to do more work, and they often lack the experience base to perform that work, especially as senior staff members retire.

Findings of the study reflecting contractor related issues are as follows:

- Given high retention rates in owner firms, contractors will face increased difficulty in hiring from owners. Also, most engineers displaced by downsizing have probably already left the industry and are not available for rehire. Without active steps to develop new hiring sources, contractors will be unable to achieve their growth targets.
- Retention in contractor firms is not high. Weak retention is also incompatible with growth. Contractors may need to take steps to improve retention, although this may be difficult given the project-based nature of their business.
- For both owners and contractors, existing sources of new hires will be insufficient to replace departing employees and to support the level of growth desired by some owner firms and by nearly all contractor firms. Firms need to address possible new sources for hiring that have not been used in the past and create the structure needed to utilize any new potential hiring pools discovered.

The second study of that developed outsourcing trends from 1994 to 1998 was performed by (Gibson et al. 2001) and utilized the CII Benchmarking and Metrics database. Three project phases, pre-project planning, design, and procurement, were analyzed, along with a rollup metric that is a combination of the three phases.

The report also examined owner project practices and attributes in regard to their level of outsourcing for a sample of 365 capital projects representing over \$18.3 billion in capital expenditures. Through a “three-tier” analysis, owners are compared on the basis of three project phases, five project attributes, five CII performance metrics, contract type selection, and three CII practice use indices. Conclusions that were drawn from the analysis include:

- Design is highly outsourced by most owners;
- Owners using a combination of in-house work and outsourcing have the best relationships with their contractors;
- Owners that outsource the most view their work as more complex;
- The most outsourced owners have the least schedule control;
- Less outsourced owners are less affected by project changes;

2.1.4 Owner/Contractor Work Structure Process

This section summarizes a Delphi study performed by Anderson et al., (October 2000). The findings of research conducted by the Owner/Contractor Work Structure (OCWS) Study Team of the Center for Construction Industry Studies, on the use and effectiveness of the OCWS process was jointly funded by The Construction Industry Institute and the Alfred P. Sloan Foundation. The OCWS process is a CII tool for determining work relationships between owners and contractors (Anderson et al. 2000).

Overall, the two reports stated and provided validation that organizations respond to the changing business environment by adapting to the demands of that environment. In the current highly competitive business environment, owner organizations developing capital projects have had to balance the demands for reduced costs and high profitability while delivering quality products and services. These effects have frequently been accompanied by: (i) downsizing; (ii) reducing or eliminating central project engineering organizations; (iii) shifting project responsibilities to business units or operating facilities; or (iv) outsourcing more work to contractors. Concurrent with this phenomenon is the gradual attrition through retirement of a whole generation of experienced managers having a solid background in engineering. The combined effect of such changes may leave owners inadequately equipped to develop and execute capital projects.

The OCWS process (Anderson et al. 2000) provided a qualitative definition of the work relationship between an owner and contractor(s), depending on the extent of their individual involvement in the planning, design or execution of a competency for a particular project, or the capital program. Since the process was conceived of as an owner-driven process, it was developed from the owner's perspective.

The study provided valuable evidence and was subsequently validated, utilizing the Delphi Method, in support of the benefits of using the OCWS process. The nature of each of the applications provided during the research also

highlighted the flexibility of the process. The following advantages of the process became evident during these applications:

- The process provided a useful mechanism for generating discussions on strategic classification of capital project competencies and has the potential to make positive contribution to the capital facility process.
- The process provided an excellent tool for communication when the participants come from diverse backgrounds and their understanding of project development and execution differs significantly.
- The process was particularly helpful in structuring capital project organizations, and aligns them with the strategic objectives of the company and the business units.
- The process provides a mechanism for assessing alignment within the owner organization, and also between the owner and other stakeholders.
- Overall, the process is a useful and flexible tool to provide assistance while structuring a capital projects organization at the corporate level as well as for a specific project.
- The concept of owner-contractor work relationship framework evoked positive response from executive managers. However, the

response of non-executive managers suggested a lack of top management perspective towards owner-contractor work relationships.

- The OCWS process may not help owner companies to mitigate the effect of knowledge lost due to retiring experts and the loss of experienced personnel to other companies.
- Executive managers and non-executive managers have different perspectives on the use of OCWS for structuring alliances. However, specific differences could not be identified in this study.
- The time required to implement the OCWS process may be different, depending on the objectives of each implementation effort.

2.2 OWNER'S BUSINESS ENVIRONMENT

This industry is a reactive industry. It reacts to what the owners want.

Irvin Richter, CEO of Hill International Inc. (ENR, 1999)

The focus of this research is the changing nature of the owner-contractor relationship in the construction industry from the contractor's perspective. Since the construction industry is a relatively reactive industry, the contractor must be able to meet the needs of their customers and be able to react to their industry specific changes. It is their ability to operate efficiently and effectively in this changing industry environment that determines their profitability and survival.

Currently, there are three major forces at work in reshaping the structure and function of the owner's business environment: core competency and strategic outsourcing strategies, business and network relationships, and organizational learning. How these three elements have impacted the owners general business

environment and how these changes have effected the owner organizations of the construction industry in the outsourcing of design, engineering, and construction services are described below (Ryan-Rose 2002).

2.2.1 Core Competency and Strategic Outsourcing

There were two prevailing strategic corporate strategies in the United States in the 1960s: unrelated diversification and vertical integration. An organization engaged in unrelated diversification sought to minimize business risk through diversification by holding a portfolio of unrelated, but profitable, business concerns. The vertically integrated industrial enterprise sought continuity and certainty through internal self-sufficiency (Edwards and Snyder, 1999). By the 1970s however, neither one of these corporate strategies was yielding consistently high returns. In light of the increasing success of Japanese firms in the U.S. markets, analysts began to notice that many of these highly successful firms had very wide market lines, yet were not very vertically integrated. These companies-- Sony, Mitsubishi, Matsushita, Honda and Yamaha in Japan and 3M and Hewlett-Packard in the United States-- used a strategy where they leveraged a few core skills against multiple markets through extensive outsourcing of support activities. Thus began the move towards what is today known as the "core competency" strategy (Quinn and Hilmer, 1994). This process, also known as the disaggregation of organizations, is described as follows:

By partnering its own particular competencies with equally competent contract suppliers of component parts and constituent services, a vertically-integrated industrial era enterprise can transform itself into a virtually integrated information era enterprise: a collaboration of competent independent components. This on-going "dis-aggregation" of industrial era institutions has become the most palpable manifestation of the drive toward competence-based enterprises. While this dis-aggregation and resulting "out-sourcing" has existed in the United States since George III hired Hessian mercenaries to suppress the American Revolution, it has assumed revolutionary commercial scale only in the 1990 's (Edwards and Snyder, 1999).

This strategy manifested itself in three concepts that were to become the corporate buzzwords of 1990s: core competencies, corporate downsizing and strategic outsourcing.

Downsizing, defined as "intended reduction of personnel," has rapidly swept across the landscape of corporate America (McKinley et al. 1997). Between 1987 and 1991, more than eighty-five percent of the Fortune 100 corporations downsized their staff (McKinley et al., 1997). Downsizing was implemented with zeal in both the private and public sectors. In 1992, Amoco had a staff of 55,000 employees. In 1998, it operated with 43,000 employees worldwide, a reduction of 12,000 people in 6 years (FCC. 1998, 21). At Public Building Services (PBS), a

branch of the General Services Administration (GSA) and the federal government's real estate asset manager, employment is down 27 percent, from 10,000 to 7,300 total employees, since the beginning of the Clinton Administration. As a benchmark, twenty years ago the staffing level was between 18,000 and 20,000 (FCC 1998,33).

As some or all of their in-house design, engineering and construction services were judged to be non-core or commodity competencies, virtually every owner organization has reengineered, reorganized, restructured, downsized, and "right sized". In their summary report, the Federal Facilities Council (FCC, 1998) noted the following significant effects of downsizing on owner organizations:

- Downsizing was not a well-planned process; mistakes were made necessitating further changes to rectify them.
- Technical competency to assist businesses in defining the most appropriate projects to meet the businesses' needs was lost.
- As their experienced and skilled personnel retire, organizations are slowly losing their ability to define alternatives effectively.
- Where downsizing has been accompanied by decentralization, the strong connection to the organization mission and vision was lost. Business units began developing their own mission and vision and losing their central focus.

- Business units develop a parochial mentality as their success is measured on their own results as a profit center. This discourages the support of other corporate objectives or other business units.
- There was the loss of the layer that converts strategy to operations and operations into a corporate direction.
- Communication now takes place between business people and contractors, because the former middlemen--the engineering staff--are no longer there to bridge the gap.

In a separate study, it was reported that engineering cost for major projects continue to grow even as the amount of work performed in-house declines. When downsizing was implemented as a cost reduction strategy, evidence shows that downsizing does not reduce expenses as much as desired and that sometimes expenses may actually rise (McKinley et al., 1997). Downsizing only becomes an effective operational strategy when coupled with a means of replacing the functional capacity lost through eliminating human capital.

To accomplish this, most organizations turned to a combination of technology and outsourcing. Outsourcing occurs when a company decides that an operation can be done more efficiently, effectively, and at a lower total cost by an outside entity. Outsourcing can be employed as a means of supplementing in-house resources or replacing them. The latter occurs when outsourcing is used to implement a downsizing strategy. An organization evaluates its core

competencies, selects the functions that will continue to be handled in-house, and restructures them accordingly. It also identifies the activities for which it has neither the critical strategic need nor the special capabilities. These activities are then transferred, or "outsourced" to external suppliers, corresponding internal assets are eliminated, and the organizational structure consolidated or "downsized."

This mix of core competency/strategic outsourcing varies from industry to industry and from organization to organization within industries. In 1990, outsourcing by U.S. corporations, government (at all levels), and nonprofits totaled less than \$25 billion per annum; by 1996, it had climbed to \$100 billion. The Outsourcing Institute projects that this will triple by 2001, to \$318 billion (Edwards and Snyder, 1999). The literature is rife with articles describing the scope of goods and services outsourced. Among the most commonly outsourced functions are accounting, warehouse operations, purchasing, maintenance, auditing, fleet management, information technology, mail room, credit and engineering services (Underhill, 1996). The outsourcing of detailed engineering began a process of downsizing in-house engineering staff. The outsourcing of design/engineering/construction services, coupled with the downsizing of in-house engineering staffs, has caused a major change in the owner organizational structure. It was in response to the impact of downsizing and outsourcing by

owner organizations that contractors were forced to undergo an organizational metamorphosis, as well.

CCIS has been collecting data on trends in owner outsourcing since 1994. Their most recent study, based on data from the Construction Industry Institute's (CII) Benchmarking and Metrics database, confirms that owner organizations have embraced this industry outsourcing trend and between the years of 1994-1998 outsourced approximately 60% of the dollars that they spent on pre-project planning, design, and procurement. The data was based on a sample of 309 owner-submitted projects, from 31 CII owner organizations, representing over \$10 billion in capital facility expenditures (Graham, 1999). This data from the CII Benchmarking and Metrics database supports the literature in documenting the trend among owner organization of classifying design, engineering and construction services as non-critical products, most efficiently and effectively procured as external services. These CII owners have followed the industry trend of outsourcing the procurement of these services. As a consequence of owners downsizing and outsourcing services, they have changed the configuration of their procurement portfolio. Owners have replaced a few contractors supplying a limited range of goods and services with a network of contractors supplying everything from accounting to engineering services. This migration to networks of business relationships and the challenges associated with managing these networks are the topics of the next section.

2.2.2 Business Relationships and Networks

As owner organizations implement the core competency strategy by downsizing and outsourcing non-critical functions, they are rapidly replacing traditional markets with networks of business relationships. The purchasing focus is "dramatically" shifting from a transaction to a relational oriented approach (Araujo, Dubois and Gadde, 1999). In their recent paper on this topic, they summarize the effects of this shift by pointing out that the emphasis has moved to the benefits that can be attained from collaborative relationships. They feel that the source of future competitive advantages will be the "type of relationship" that firms have with their suppliers. The control of resources, as well as access to resources controlled by other parties, will define a firm's competitive advantage (Araujo, Dubois and Gadde, 1999).

As previously discussed, the implementation of the core competency strategy resulted in organizations outsourcing their non-critical functions. This changed their corporate structure, which in turn changed their customer-supplier link from a collection of dyadic relationships to a portfolio of network relationships. Structuring and managing this portfolio of network relationships requires new individual and organizational skills. Just as this change in corporate strategy altered the structure of the organization, it also impacted the knowledge creation process, the process by which individuals and organizations acquire and maintain knowledge and skills. Since organizational knowledge determines how

effectively an organization can maintain its competitive advantages, this change in the knowledge creation process or organizational learning, dramatically affects an organizations ability to successfully implement and function within the core competency strategy. The next section discusses this transition in organizational learning.

2.2.3 Organizational Learning

The globalization of competition, tremendous improvements in global transportation, and the ever accelerating rate of technological advancement have made most materials, tools and processes available to all of the competitors within a given industry (Hakansson, Havila and Pedersen, 1999). Cutting edge technology has now become a short-term competitive advantage for organizations looking for long-term competitiveness and survival (Levy, 1996). Stata argues in his 1989 article that, "the rate at which individuals and organizations learn may become the only sustainable competitive advantage, especially in knowledge-intensive industries."

The concept of organizational learning is difficult to define. In his article on this topic Stata contends,

We tend to think of learning as a process by which individuals gain new knowledge and thereby modify their behaviors and actions. Similarly, organizational learning entails new insights and modified behavior. It

differs from individual learning in several respects. First, organizational learning occurs through shared insights, knowledge and mental models. Thus organizations can only learn as fast as the weakest link. Change is blocked unless all of the decision makers learn together... Second, learning builds on past knowledge and experience -that is, on memory. Organizational memory depends on institutional mechanisms used to retain knowledge. (Stata, 1989)

As organizations transition from vertically integrated systems to a horizontally ordered network of systems through the implementation of the core competency and strategic outsourcing strategies, they must also change the way they organizationally learn. Like individuals, organizations have explicit and tacit knowledge. Examples of organizational explicit knowledge are checklists, design specifications, organizational charts, and procedures. The purpose of making organizational knowledge explicit is so that it does not depend on the actions of a single individual and can be disseminated to others. An organization's tacit knowledge is knowledge that is known by the organization without being expressed explicitly (Baumard, 1996). Organizational learning is derived from the transformation of individual knowledge into artificial memories and routines. It is important to create organizational knowledge for organizations to learn so that the individuals that make up the organization have a mutually understood framework within which they can efficiently cooperate and function. Mutual

knowledge and organizational memory are also important to insure organizational consistency and continuity independent of individual affiliation and longevity.

2.2.4 Owner Organizational Change Study

As previously discussed the Center for Construction Industry Studies (CCIS) in conjunction with funding from the Alfred P. Sloan Foundation and Construction Industry Institute (CII) is currently conducting a parallel study to identify changes in the owner-contractor relationship from the owner perspective.

The Owner Organizational Changes Study has completed a Phase I Pilot Stage and a Phase II Study. The Owner Phase I Study was a pilot stage study conducted over a 10 month period that allowed the study team to identify several critical findings that provided the basis for the next phase (Gibson et al. 1998). During Phase I of its work, the study team conducted one corporate site visit and 11 interviews with seven companies. The results of the Owner Phase I Study were published in March 1998 and formed the basis for the Phase II study. The Owner Phase II Study findings were published in April 1999 (Davis-Blake et al., 1999). During Phase II of its work, the owner study team conducted in-depth telephone interviews and site visits at two owner firms. In total, the Owner Phase II study team conducted 42 interviews with 37 individuals. In some cases, the team visited multiple geographic locations for a single owner. Their research focused on the

changing nature of the Owner-contractor relationship for capital facility projects, from the owner perspective.

The following is a summary of the findings from Phase II of the Owner Organizational Changes Study (Davis-Blake et al. 1999):

- The owner-contractor relationship appears to have many purposes, not all of which are fully recognized by owners. The basic purpose of the relationship is to allow the owner the flexibility to access the skills of large numbers of engineers as needed without retaining those engineers on the payroll. One of the things that makes managing the owner-contractor relationship difficult is that the kinds of leverage the owner firm expects are often not made explicit and may not even be agreed upon within the owner firm. A structured process to address this issue prior to beginning the relationship could help.
- Goal conflict is a critical, but often-unrecognized feature of the owner-contractor relationship. The most common complaint that owners voiced about contractors was that contractors "don't think like owners." Many owner personnel saw this lack of goal congruency as a symptom of difficulty with the contractor or with the owner-contractor relationship. In fact, goal conflict may not be a symptom of difficulty, but may instead be a natural outgrowth of

the fact that owners and contractors have different business objectives. The owner-contractor relationship needs to be structured so that each party can meet their separate goals.

- Another defining feature of the owner-contractor relationship is the level of owner involvement in projects. At one extreme, the owner determines only the economic viability and key design features of the project. At this point, the owner basically turns the project over to the contractor. While the owner maintains oversight of the project, owner personnel are not involved in day-to-day decisions made by contractor personnel. At the other extreme, owner personnel maintain active involvement with the contractor throughout all phases of the project.
- The way in which the contractor's involvement with the owner is structured also plays a key role in the owner-contractor relationship. Models of contractor involvement could be arrayed along a continuum. At one extreme, the owner and the contractor have a formal, written highly specified alliance that is agreed upon and managed at fairly high levels in both firms. The other extreme model of contractor involvement consists of the owner getting bids for the design or construction of each facility and giving the contract to the low bidder (other factors being equal). An

intermediate form of contractor involvement is the preferred provider relationship. In this method of organizing, the owner tends to work with the same small number of contractors over time to develop good working relationships with those contractors. However, the owner has no long-term contractual obligation to any of the contractors.

- Communication difficulties between owner and contractor are the most commonly cited problem in the owner-contractor relationship. While owners and contractors use a wide variety of formal and informal coordinating mechanisms, it appears that existing coordination mechanisms are not sufficient to meet communication needs. Although increasing dependence of owners on contractors means that good communication between owners and contractors is more critical than ever, there appears to be little systematic attention by owner firms to designing coordination mechanisms that fully meet their communication needs.
- The study team encountered many examples of attempts to increase knowledge sharing and learning between owner and contractor personnel. However, like coordination and monitoring, the area of learning is one where owner firms' work structures have not kept pace with the demands of new kinds of owner-contractor

relationships. Although owners desire to learn from contractors and cite increased learning as an important benefit of alliance and preferred provider relationships, owner firms still do not have systematic structures for assessing and documenting their learning from contractors.

- Monitoring and evaluating contractor performance is another area where work structures have not kept pace with the changing nature of the owner-contractor relationship. Although owners have at least some metrics for project performance, few instances were found where owners had clear metrics that could be used to assess the performance of relationships. Developing methods for assessing relationship success appears to be an important future challenge for owners.
- The owners identified many specific attributes of successful owner-contractor relationships. Table 1 lists these attributes from the owner perspective into seven basic categories.
- It is clear that individuals use the term "alliance" to mean many different things. It is impossible to answer the question of whether alliances are beneficial without specifying in more detail the specific structure of the alliance and the behaviors that underlie the

alliance. One thing is clear: simply calling a relationship an alliance does not increase the probability of relationship success.

**Table 1. Attributes of a Successful Owner-Contractor Relationship:
The Owners Perspective**

Source: (Davis-Blake et al. 1999)

Attribute	Definition
Contractor meets owner's project objectives	The project is delivered on or ahead of schedule and budget targets with minimal rework in the field. Startup is smooth.
Contractor understands owner's business	Contractor personnel understand owner's business objectives and operating systems and procedures.
Integration of owner and contractor personnel	Owner and contractor work together repeatedly, using many of the same personnel from project to project. Owner and contractor develop effective communication structures, a shared vocabulary, and a common project culture. Owner and contractor systems are integrated to the extent possible. Trust develops between owner and contractor personnel. Multiple levels of personnel are involved in both the owner and contractor organization.
Contractor responsiveness to changing conditions	Contractor responds quickly and effectively to owner needs. Contractor informs owner as early as possible about upcoming difficulties.
Contractor willingness to innovate	Contractor is willing to challenge owner ideas, recommend improvements, and take risks.
Operating for mutual benefit	The relationship benefits both owner and contractor. Gains made through a productive relationship, such as cost savings, are shared between the owner and contractor.
Learning from the relationship is documented and used	Owner and contractor explicitly discuss and document the lessons learned from each project. If possible, these lessons are integrated into systems and procedures that can be reused on subsequent projects.

- Although individuals discussed the idea that alliances can create common interests between owners and contractors and improve information flow, there were no methods of documenting whether these benefits actually occurred. It is important to note that a successful relationship and successful projects are two different things. A successful relationship overall may still have projects with a variety of outcomes.
- To work effectively with contractors, owner personnel require a number of traits that are not easily developed after hiring. When owner personnel operated in a carefully controlled environment where their behavior was shaped by starting "at the bottom" with very little responsibility and taking on a gradually increasing amount of responsibility over the years, selection based on these traits would be less important. However, given that owner personnel may now have few peers to shape their behavior and operate autonomously from an early stage in their careers, selection based on these traits may be more essential. Table 2 lists the traits to be considered during the selection of owner project professionals.

Table 2. Traits to Consider during Selection of Owner Personnel

Source: (Davis-Blake et al.1999)

Trait	Definition
Agreeableness	Ability to get along with others and be open minded to new ideas.
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.
Confidence	Trust in one's ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.

- Owner personnel are unanimous in their view that changing owner-contractor relationships require owner personnel to have new skills. It is fairly widely recognized in owner firms that the skill set required to manage and work on projects from the owner's side has changed dramatically (e.g., more "soft" skills are important; deep technical knowledge is less important). It is widely recognized that, in order to work effectively in an environment where contractors are used extensively, owner personnel must

possess a variety of skills. Table 3 lists these skills and divides them into six categories.

Table 3. Skills Required by Successful Owner Project Personnel

Source: (Davis-Blake et al.1999)

Category of Skills	Examples of Skills
Business Skills	Writing and managing contracts Negotiation Managing budgets and schedules
Communication Skills	Coordination/liaison Conflict management Cultivate broad network of relationships
Influence Skills	Mentoring Motivating Change management
Managerial Skills	Team building Delegating Politically aware/see big picture
Problem Solving Skills	Continually analyze options/innovation Planning Consider both sides of issues, risk management
Technical Skills	Understand entire construction process Multi-disciplined (knowledge of several areas of engineering) Information technology skills

Although the skill sets required of owner personnel has changed radically, owner firms have invested relatively little systematic effort into methods for ensuring that their personnel have the required skill sets. There is relatively little investment in formal training (either from the owner's training organization or from outside providers); owners rely almost exclusively on on-the-job training.

The issue of skill development of owner personnel is perhaps the most important difficulty facing owner firms.

- Currently, the full impact of this lack of training has not affected owner firms. Owner firms currently rely on the few experienced personnel that they have retained in-house. The tenure distribution is heavily skewed toward individuals with more than 15 years of experience and reflects very limited hiring during the past five years. As the current cadre of long-tenured individuals retire and need to be replaced, the effects of lack of training will become more critical.
- At most owner firms, hiring of new engineers has been relatively limited. Thus, owner firms have had little chance to experiment with developing new career paths to train the next generation of project managers. It is unclear what career path and which experience leads to the project manager role, which makes future staffing of this role quite difficult. Similarly, there does not appear to be a career path out of the role, which may lead to problems with both burnout and retention.

In summary, the Owner Phase II Study found that owner project professionals face the daunting task of continuing to service capital programs with

a shrinking work force. Alliances are used to "fill the gap," but are not being systematically developed or measured. Revitalization of work force on the owner side is a pressing issue with few concrete solutions. New skills and worker traits are needed to manage the more complex relationships that have evolved. Contractors face many of the same issues and although opportunities for more work are available, the risk of doing business is increasing in many cases, as well.

From the Owner Phase II Study, the teams overall conclusion was that the relationship structure between owners and contractors has changed significantly over the past several years, while the corresponding work processes and resources needed to manage these changes have been slow to catch up.

2.3 CONTRACTOR'S BUSINESS ENVIRONMENT

This section focuses on the industry-specific changes to which contractors must manage and adapt if they are to stay competitive within the construction industry. The following topics are discussed in greater detail in this section:

- Construction Industry Trends
- Partnering and Other Business Relationships

This section should assist in establishing the industry stimuli the contractor community must manage to maintain a profitable, competitive position within their industry. The previous section discussed the three major forces at work in reshaping the structure and function of the owners' business environment:

the core competency and strategic outsourcing strategy, business and network relationships, and organizational learning. It also explored the impact of these initiatives on the owners' general business environment and how these changes have impacted owner organizations as they interface with the construction industry in the outsourcing of design and engineering services.

This section focuses on the industry-specific changes to which contractors must manage and adapt if they are to stay competitive within the construction industry. This section also discusses the use of collaborative relationships by the construction industry as an adaptive behavior mechanism in managing change.

2.3.1 Construction Industry Trends

To mark its 125th anniversary, Engineering News Record convened a panel of industry experts to explore the changes and issues ahead for the construction industry. The panel participants focused on past, present and future industry trends in five main areas: work force, project delivery, companies, economics, and technology (ENR, 1999).

The recruitment of new employees and the retention of existing employees across all segments of the industry were cited as one of the major threats to the continued growth and development of the construction industry. Despite efforts to increase the level of industry automation, the construction industry still relies very heavily on its human capital. Among the reasons cited for the inability to attract and retain personnel were:

- The construction industry is now competing with many other industries for the "knowledge worker." In the race to recruit the best and brightest candidates from a diminishing supply of technical graduates, the construction industry cannot compete with the high-tech industries in terms of salary, benefits, career path, and career status.
- The industry has been slow to encourage diversity within its ranks, especially among nontraditional groups like minorities and women.
- Industry has done little to educate and inform potential future employees about the industry and continues to view the professional growth and development of current employees as an individual responsibility.

The industry's ability to develop a supply of talented educated people and to retain their current talent is considered a factor in determining whether the construction industry stagnates or continues to grow.

Most of the discussion regarding changes in the project delivery system really served as a platform from which to explore changes in the owner organizational structure, particularly owner outsourcing and downsizing. The comments show an industry struggling to understand this trend, perplexed by the extent of its impact on the construction industry and trying to ascertain an appropriate response. Norbert Young, president of the Construction Information

Group of McGraw-Hill summed the industry confusion up best, "I think the industry should stop worrying about different project deliveries and putting things in boxes and figure out what the client is really after and how you deliver that (ENR, 1999)."

This confusion regarding their client base is only compounded by uncertainty within the construction industry. The industry is under increasing economic pressure. The commodity pricing of services has held down profit margins. The entrance of new competitors has threatened market share for some. Increasing costs due to a shrinking labor supply and the need to be a player in the global market have increased operating costs. Opinions are mixed on whether the industry will remain fragmented with a Darwinian approach to survival, or it will respond with a mega roll-up (ENR, 1999). These issues have only been exacerbated by the economic downturn in the past two years.

Owner firms are expanding the types of services that they are looking to contractors to supply. "Project financing is fast becoming as important a factor in winning jobs as low price and high technology. Knowing how to bring money to the table is critical for many firms and communicating numbers with owners a must (ENR, 1999, 53)." This is requiring contractor firms to broaden their areas of expertise beyond those associated with traditional construction means and methods, with sometimes disastrous results as in the case of ENRON's bankruptcy.

In construction, technology is transforming the industry. Its influence reaches into every facet of the industry. It is causing changes in workforce management through 24-hour engineering, work sharing, and improved access to information and communication. It is creating cost savings by increasing productivity, shrinking the globe and reducing the impact of time and distance. It is improving a firm's competitive advantage by insuring that critical information is updated and widely available. Yet amidst this unprecedented progress, the panelists sounded a word of caution. In an industry notoriously resistant to change, there is concern about the widening management gap and those associated barriers to progress caused by technology challenged boardrooms. The ability of the industry to manage the changing skill base required of the new technocrats and provide the training to update the skills of their existing employees is of concern.

2.3.2 Collaborative Business Relationships

Until a few years ago, the large, integrated organization was the undisputed king of the business jungle. Now, its crown is being contested by more sociable corporate creatures, hunting in packs. The intensity of the competition is not abating -quite the contrary - but the primary competition agent is changing. Co-operation is ceasing to be the opposite of competition, and is becoming instead one of its preferred methods. (Deering and Murphy, 1998)

The ability to create value through the development and management of portfolios of business relationships is becoming fundamental to an organization's ability to compete effectively in the global market. In the major financial newspapers, the Wall Street Journal, The Financial Times and Reuters News-Far East, mentions of partnerships, joint ventures and strategic alliances quadrupled between 1987 and 1995 (Deering and Murphy, 1998). Recent studies by Booz-Allen & Hamilton (1995) showed that US companies formed only 750 collaborative relationships, e.g. licensing agreements, collaborative research, joint ventures, technology exchanges etc., in the 1970s, but are now forming thousands each year. The study estimated that the top 1000 US companies now draw 6% of their revenue from alliances, compared with 1.5% in 1987 (Deering and Murphy, 1998).

In response to increased global competition, eroding profit margins, the fragmentation of the design and construction industry, changing client organizations and increased reliance on formal litigation to resolve disputes, a partnering movement emerged in the construction industry (Larson, 1995). Partnering is based on the realization that the traditional adversarial relationships between owners and contractors are ill-equipped to survive major disputes. As litigation became the industry's solution to dispute resolution, it was increasingly apparent that there were no winners, except perhaps the attorneys. Abraham Lincoln offered the following advice to attorneys, widely quoted in the legal

community today, "Discourage litigation. Persuade your neighbors to compromise whenever you can. Point out to them how the nominal winner is often a real loser in fees, expenses and waste of time."

According to the Construction Industry Institute (CII) (In search, 1991), partnering is "a long term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources." In 1994, CII commissioned the Partnering II Research Team. A key finding of this research was that the term "partnering" had become a generic term for a wide spectrum of collaborative relationships.

Business literature is full of examples of models of the collaborative process within the owner-contractor relationship. They may vary in the number of steps, the titles of the phases and the verbiage used to characterize each phase. Fundamental to all of these models is that the development of a collaborative relationship between two organizations, much like human relationships, is a process. Underlying the process, is a series of steps, each step requiring the participants to make a greater commitment of resources based on a shared vision grounded in mutual trust to create a tangible benefit. So, how well do collaborative relationships work? Some of the literature suggests that 50 percent of the strategic alliances and as many as 80 percent of the supply chain partnerships fail to add value (Deering and Murphy, 1998). It is not clear from the literature why the failure rate is so high. A hint may come from the research

conducted on collaborative relationships that have been successes. In a research study conducted by Baker in 1994 and based on the study of more than 700 public projects that were completed using a partnering approach, one of the most commonly cited difficulties was measuring the specific benefits of partnering. This was cited as one of the most frequently occurring problems, both by the organizations that had measurement programs and those without (Baker, 1996). As the research focus shifts from how the collaborative relationship process works to what makes the collaborative relationship process work, there is the dawning realization that this new model of collaboration requires a new set of principles and a different set of skills to make it work.

2.4 SUMMARY

Based on the literature review presented in this chapter, it is apparent that the construction industry and specifically the contractor community have been embattled in the marketplace on two fronts; first, by the changing structure of their market in the form of the customer-contractor link and second by the changing nature of their industry. Being able to successfully negotiate this dynamic market-industry interface will be fundamental to the survival and success of the contractor community. Yet, the boundaries of this interface are becoming increasingly blurred as it is constantly reformed, becoming more dynamic and trying to keep pace with the ongoing changes in both the owner and contractor

components of this business environment. It is also apparent from the literature review, that scant research has been done on owner-contractor organizational changes in general, and no research on this subject from the perspective of the construction industry and the contractor community. Documenting the effect of this turbulence in the market-industry interface from the contractor's perspective is the initial step in developing an industry specific management philosophy, principals and practices.

Chapter 3: Research Methodology

This chapter presents the methodology used to support and conduct the research contained within this thesis. The source of data for this research is from three surveys sent to various contractor owned companies, from information gathered from previous research related studies from the Center for Construction Industry Studies (CCIS), specifically CCIS Report No. 11, on other Owner Organization related documents from CCIS, and from an unpublished manuscript created and researched by Mrs. Donna Jean Ryan-Rose (Ryan 2002).

3.1 METHODOLOGY OVERVIEW

From a review of the business, management and engineering literature, it is apparent that there has been little research done on owner-contractor organizational changes in general, and no research on this subject from the perspective of the construction industry and the contractor community. Because of the lack of any substantive research in this area, the study team developed a two-phase research plan: a pilot study followed by a more comprehensive structured exploratory study based on the findings of the pilot study.

The development, research, data analysis, and writing of the report for the Phase II study, subject of this thesis, was performed in two parts. The first part of this research study was performed by Mrs. Donna Ryan-Rose under the guidance

of Dr. G.E. Gibson, Professor at the University of Texas at Austin, and the second part of this research was performed under the guidance of Dr. G.E. Gibson, by the author, Mr. Cameron Geertsema. The non-highlighted areas in Figure 1 below are those research areas executed by Mrs. Ryan-Rose. Those areas shaded in Figure 1, such as data entry and analysis, and report generation were conducted by the author. The area of “Data Gathering & Entry” was a joint effort, however, with the exception of minor data entry was conducted by Mrs. Ryan-Rose. The work-flow diagram outlines the process from inception to completion.

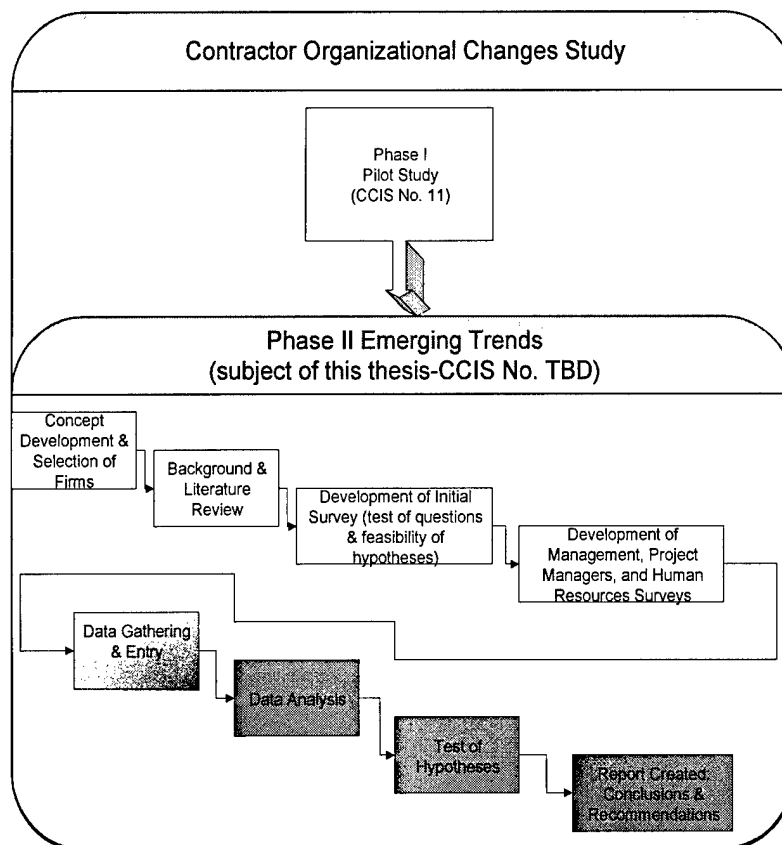


Figure 1. Phase II Emerging Trends Work Process Diagram

3.2 PHASE I CONTRACTOR PILOT STUDY

Phase I of the Contractor Organizational Changes initiative was a ten month pilot study focused on identifying the trends in the contractor community developed in response to the changes in the owner organizational structure from the contractor's perspective.

3.2.1 Phase I Contractor Pilot Study Objectives

The Phase I Contractor Pilot Study had the following objectives:

- Identify how the use of contractors by owners has changed over the past five years, the cause of these changes and how the contractor has organizationally adapted to these changes.
- Identify changes in the nature of the current owner-contractor relationship precipitated by changes in the use of contractors by owners, the characteristics and attributes of these relationships, the benefits of these relationships and the measurement and evaluation methods used to coordinate and monitor these relationships.
- Identify the human resources impact on the contractor by changes in the use of contractors by owners.
- Identify the impact of changes in the use of contractors by owners on project performance.

- Identify future issues and challenges facing the contractor community on capital projects resulting from the current or anticipated changes in the use of contractors by owners.

3.2.2 Phase I Contractor Pilot Study Target Population

The target population for this study consisted of organizations that are providers of architectural, engineering and construction management services to corporations that construct own and operate commercial or industrial facilities. For the purposes of this study, these contractor organizations must be independent legal entities separate and distinct from the owner organizations for which they provide services.

Within the contractor organization, the target population consisted of those individuals responsible for developing, coordinating, and maintaining the client-contractor relationship interface or the client-contractor project interface.

3.2.3 Sources of Error and Bias for Phase I Study

The Phase I Contractor Pilot Survey yielded a wealth of information in the topic areas of interest to the researcher. However, the external validity of the Phase I Contractor Study is questionable due to the use of the non-probability sampling method. The consistent degree of response replication among the participants and the similarity of these findings to those from the Phase II Owner Study lend credibility to the internal validity of these data. The use of the same

interviewer to conduct all of the telephone interviews coupled with the interviewer's extensive experience in this field could have created interview competence bias. The design of the survey to utilize exclusively open ended questions, none dealing with socially acceptable responses or roles or requiring the rating or evaluation of statements, should have insulated it from change agent and response set bias. Despite its questionable external validity, the internal validity of these data from the Phase I Contractor Pilot Study makes it a suitable basis from which to formulate a more comprehensive initiative (Gibson and Ryan 2000). The next section of this proposal presents the research plan for this more comprehensive initiative, the Phase II Contractor Study.

3.3 PHASE II CONTRACTOR STUDY

3.3.1 Phase II Contractor Study Investigation

The population for this study is all of the organizations that are providers of commercial and/or industrial architectural, engineering and construction management services to owner firms. For the purpose of this study, an owner firm is defined as a direct user of these services for the development, construction, renovation or maintenance of facilities or infrastructure owned, occupied, operated and maintained directly or indirectly by the owner firm in support of their primary business function. Commercial real estate developers are not

considered owner firms for the purposes of this study. Since they are not the end users of the facilities that they construct, their goals, objectives and priorities in the design and construction of these facilities tends to differ from firms that own, occupy, and are financially responsible for the operation and maintenance their facilities. The residential sector of the construction industry has also been excluded from the investigative domain. The residential market lacks synergy with the commercial/industrial markets in terms of typical project cost, design, construction and operational complexity, project duration, facility lifecycle and investment criteria.

3.3.2 Study Survey Population and Sample Selection

Engineering News Record (ENR) is a trade publication for the construction industry. ENR annually ranks the major domestic and international design, engineering and construction management firms by dollar volume. For this study, the researcher selected as the sampling frame the 1998 Engineering News Record listings of the top 100 domestic design, engineering and construction management firms. The sampling frame was limited to domestic firms for expediency, convenience, access and cost.

Based on the study schedule, a target sample size of 20 firms was established. The sample element for this study is a specific architectural, engineering or construction management firm. The study sample elements were selected from the sample frame using a non-probability convenience sampling

method. Starting with the number one firm, an architectural, engineering and construction management firm was added to the sample listing in alternating sequence until 23 firms or sample elements had been selected and the sample was reasonably balanced among firm types. Since participation in this research is on a strictly voluntary basis, over sampling was used in anticipation of attrition among the sample elements. See Appendix A for a list of the participating companies.

Once the sample elements were selected, an appropriate contact within each candidate firm was identified either through industry sources or through the firm's literature. A solicitation letter was mailed to the contact person in each candidate firm. The letter provided background on the research, extended an invitation to participate, identified the resource commitment required of participants and explained the follow up procedure. Once the non-participants in the original sample have been identified, a second sample group of candidate firms will be selected using the same sampling frame and method. The process will be repeated until the required sample size is achieved.

3.3.3 Study Survey

This section discusses the measures that were used by Ryan-Rose (2002) to collect data required to test the proposed research hypothesis. This research, Contractor Phase II Study, used a survey format combining Likert scale statements with open-ended questions administered via mail to obtain preliminary

data on the research hypotheses. With this information three surveys were then developed by Ryan-Rose in conjunction with the supervision of this thesis using a similar format. The first survey collected data on the strategic nature of owner-contractor collaborative relationships from management representatives of the candidate firms. The second survey collected data on the tactical nature of owner-contractor collaborative relationships and project specific data for projects developed and executed with and without the benefit of an underlying collaborative relationship. This survey was administered to project managers of the participating companies. The third, and final survey, targeted specifically information on the recruiting, hiring and career paths of the professional staff within the contractor organizations and was administered exclusively to the human resources representative for each candidate firm. Each of these surveys was piloted-tested on one or two respondents to ensure they worked effectively.

Both the Management and Project Manager surveys contained face sheets that discussed anonymity and requested for generic professional information. The Management survey then requested project specific and owner-contractor strategic collaborative relationship information about each of a possible four candidate projects. The Project Manager survey requested project specific and owner-contractor tactical collaborative relationship information about the specific candidate project. Additionally, for cross validation with the human resources

survey, both surveys concluded with several questions on training, skill development and career path opportunities.

To provide a quantitative measure for this research study, the performance of capital facility projects in the candidate firms has been selected as the unit of analysis. As a result of studying capital facility projects the research might further identify how collaborative relationships exist in the business environment and achieve tangible results for their partners.

The causal relationship that is the focus of this research is that capital facility projects developed and executed within a collaborative relationship are more successful. In order to test this relationship, there must be variability in the variables. To insure this variability, the management of each of the candidate firms for the Management and Project Manager surveys will be requested to select four capital facility projects for this study according to the following criteria:

- Owner-contractor relationship: to provide variability within the independent variable, each candidate firm will be requested to identify four completed capital facility projects. Two of the capital facility projects should have been developed and executed with owner firms that the candidate firm had no formal or informal owner-contractor relationship. Two of the capital facility projects should have been developed and executed with owner firms with which the candidate firm had an existing formal or informal owner-contractor relationship.

- Project performance: to provide variability within the dependent variable and within each owner-contractor relationship category, each candidate firm will be requested to identify a completed capital facility project with an above average performance and a completed capital facility project with a below average performance.
- Project size: the total project cost for each of the candidate projects should be at least \$2 million dollars. This is to insure that the candidate projects are all of comparable strategic importance to both the owner and contractor firms. Projects at or above this threshold typically require formal management review and approval.
- Project location: the project should have a domestic (North American) location. This requirement seeks to minimize variability in the project delivery process, project costs, construction means and methods, and team roles and responsibilities by taking advantage of the legislative, judicial and industry standardization that exists in the domestic construction industry.
- Project timing: the project should have been completed within the last two years. This requirement seeks to minimize the variability in the project performance from the time series effects of changing monetary valuation, technology, labor availability, and other market factors.

- Project team: the primary project manager is- still employed by the company. This is to insure the study team has access to the relationship data for each firm. The Phase I Contractor Pilot Study indicated that contractor firms are very effective converting project performance data into organizational explicit knowledge, but relationship data is usually stored as individual explicit data. To recover this data, the study needs access to the repository.

3.3.4 Study Data Collection

A two-stage data collection process was used in this research project, one for the collection the owner-contractor relationship and project performance data and one for the collection of human resources data. This section describes each stage of the proposed data collection process in detail (Ryan-Rose 2002).

The Contractor Phase I Study found a distinct hierarchical component to the development and implementation of owner-contractor relationships. Almost without exception, the study found that these relationships were developed at the owner-contractor management level and implemented by owner-contractor project level personnel.

As previously described, a multi-level data collection process is being proposed to collect the owner-contractor relationship and project performance data in this research project. A survey was developed and administered to the candidate firm management representative, e.g. Vice-President of Business

Development or Vice-President of Design/Engineering. A second survey was developed and administered to the project manager of each of the candidate projects. This survey focused on the tactical nature of the owner-contractor relationship and documented the tactical details of each of the candidate projects. Each of these surveys required approximately one hour to complete. Each survey was mailed to the candidate firm's and completed by a member of the contractor organization. The candidates did not receive an advance copy of the survey.

The Human Resources data was collected using a separate survey administered to the human resources representative responsible for hiring project personnel. This survey was mailed, faxed or e-mailed to the candidate firm's Human Resources (HR) representative in advance of the site visit to the candidate firm. The HR representative was requested to complete the survey in advance and review their responses with a member of the study team during a brief face-to-face meeting while the study team is on site. Total sample sizes for all three surveys are given in Table 4.

Table 4. Total Surveys from Participating Companies

PARTICIPANT	OWNER-CONTRACTOR RELATIONSHIP	SAMPLE SIZE
Management Interviews		9
Project Management Interviews	No Existing Collaborative Relationship	40
	Existing Collaborative Relationship	
Human Resources Interviews		11

3.3.5 Statistical Analysis

The statistical analysis of this research was performed by the author of this thesis. When possible, the analysis utilized descriptive statistics to provide a breakdown of the respondent answers. Some of the descriptive statistics provided in the analysis of this thesis include: the mean, median, and standard deviation. Additionally, when applicable, Analysis of Variance-One way (ANOVA) was used (Albright et al. 2003). The reason for such measures was to provide a statistical verification of difference in means required to determine if a possible difference between various variables (factors) occurred. The author selected a level of significance of 0.05 for all ANOVA trials. This value represents a generated p-value or level of significance to determine whether or not the null hypothesis (H_0) is valid. The null hypothesis is that the means are all equal; whereas the alternatives, alternate hypothesis (H_a), are that they are not all equal. If the p-value of the analysis is less than the 0.05 level of significance and more importantly closer to 0.00, then you can conclude there is a difference among at least two of the population means. However, it should be noted that many possibilities exist (Albright, et al. 2003). Therefore, to analyze which possibilities might provide more significant results you then proceed to examine the individual confidence intervals to determine which population means are different.

When the p-value was significantly small enough to reject the null hypothesis the researcher provided additional analysis utilizing confidence

interval analysis with the Tukey method. The Tukey method is the most acceptable, a very robust test, and commonly used for pair-wise comparisons between differences of means when considering small populations. The researcher utilized a test confidence interval of 95 percent. If the test verified a significant difference upon utilizing the confidence interval then the associated factors could be explicitly separated between one another. Analysis of the data was done using a Microsoft Excel add-in called STATPRO™.

3.3.6 Sources of Error and Bias

As noted in the Contractor Phase I section on sources of error and bias, threats to the valid interpretation of a difference are broadly divided in to three groups: error from those being studied, error from the investigator and error associated with the sampling method (Webb et al., 1981). This section examines these categories of error as applied to the proposed Phase II Contractor Study (Ryan-Rose 2002).

Error associated with the sampling method is usually categorized by assessing the internal and external validity of the sample estimators. The Phase II Contractor study employed a non-probability sampling method to establish the sample frame. The sample elements were then selected from the sample frame on a quota basis e.g. equal numbers of candidate firms were selected from the sample frame by firm type. As attrition occurs among the original sample elements, their replacements will be selected to maintain the firm type quota. This process should

result in a sample more representative of the population improving the external validity of the sample estimators. While the sample frame could have been randomized, and a probability sampling method applied, the research team felt that the reduction in external validity was justified by the access to more extensive project and owner-contract relationship data anticipated within the larger candidate firms. Despite this, the lack of external validity caused by the use of a non-probability sampling method will compromise the ability of the study to generalize about the population from the sample data. The Phase I Contractor Pilot Study and the Phase I, II Owner Studies will be available for use in establishing the internal validity of the Phase II Contractor Study findings.

Unlike the Phase I Contractor Study that used open-ended questions as its primary measure, the Phase II Contractor Study will use a combination of Likert scale statements followed by open-ended questions. The open-ended questions are intended to give additional information and to clarify the Likert scale statements. Studies have shown that respondents more frequently endorse a statement than disagree with its opposite and have a preference for strong statements versus moderate or indecisive ones. Respondents were not given an advanced copy of the survey to avoid consultation with their peers regarding appropriate or acceptable answers. To further guard against respondent error, all the data was considered to be confidential. Participants were assured that personal information and project specific information would be sanitized from the summary report.

Chapter 4: Data Analysis for Human Resources Survey

4.1 OVERVIEW

As previously stated in the background chapter, the Phase II Owner Study found that owner personnel are unanimous in their view that changing owner-contractor relationships require owner personnel to have new skills. Also, it is important to understand that just as the owner organizations change so must the contractor organizations to support the new working trends within the industry. So, in order to work effectively in the new highly dynamic environment, contractor companies and personnel must adapt and change in order to possess the variety of skills required to succeed in today's industry.

The precursor to this study, CCIS report No. 11, reported that the future industry challenges will center on the following themes:

- People are being asked to do things that they have never done before.
- Finding qualified individuals to meet the demands of the industry at all levels, from the trades through project managers, was cited as a key industry issue.
- Availability of qualified senior personnel is already becoming an issue.

- With the escalating workload, several participants expressed concern and frustration about their limited ability to mentor subordinates, further eroding the pool of qualified individuals.
- Entry level project staff will have different occupational status expectations than their predecessors. New employees enter the workforce with very clear ideas about what roles and responsibilities are position appropriate and are viewed to lack the "I'll do anything attitude" of their predecessors.

Additionally, within the competency requirements for contractor project personnel, there has been a major shift in emphasis from technical skills to communication and interpersonal skills. Also, in the past, people rose through the industry ranks. Now, more people are entering the industry with a college education.

Contractors increasingly view the owner representatives "as the organizational translator and guide." Since the project team is increasingly composed of non-owner personnel, a good grasp of the owner organization's goals, values and objectives by the owner's representatives are highly valued skills.

Therefore, it is the purpose of this section to analyze whether the industry is providing their personnel with the requirements and organizational structure required to transition to the network management of business relationships.

4.2 SAMPLE CHARACTERISTICS

A total of 11 companies participated in the Human Resources (HR) portion of this research study. All but one company participating in this portion of the study provided information for the management and project management portions of this research. A complete list of participating companies can be found in Appendix A and an example of the HR survey is provided in Appendix B of this thesis.

Of the 11 respondents six provided construction management services, three provide project engineering design services, one provided additional architectural design services, and two did not provide enough information to ascertain primary business focuses.

4.3 SELECTION OF APPLICANTS

Initially, it was found that of the 11 companies participating in this survey, when hiring for the project functions, received on average five applications per position, with a median value of three applications, and a standard deviation of 5.4.

When analyzing factors that the respondents utilized for various hiring practices, the following scale and question was formulated and utilized:

1-----	2-----	3-----	4-----	5-----	6-----	7
Very Little Weight		Moderate Weight			Very Heavy Weight	

What weight do you give the following factors when hiring for this project function?

Table 5 presents in rank order those individual factors companies are currently searching for in applicants.

Table 5. Hiring Factors for Applicants of Companies

Factors	Mean / Median
General experience in your industry	6.4 / 6.0
Ability to work with others	6.3 / 6.0
Previous experience in this project function with a contractor firm	6.0 / 6.0
Willingness to learn new skills	5.4 / 6.0
Previous experience in this project function with an owner firm	5.0 / 5.0
Quality of institution(s) where degree(s) were received	4.3 / 4.0
Completion of a master's degree	2.5 / 2.0

It should also be noted that the ANOVA test yielded a p-value of 0.000 which fell below the 0.05 level of significance and therefore, resulted in a possible difference in means between at least one of the factors. When applying the Tukey method of analyzing confidence intervals a significant difference resulted between all factors listed above and the completion of a master's degree. Additionally, it should be noted that the quality of the degree from an institution was significantly different when compared to general industry experience, the ability to work with others, the willingness to learn new skills, and the completion

of a master's degree. In summary, experience and ability to work with others generally outweigh education in choosing new employees.

4.4 HIRING TOOLS

When respondents were asked about what and how frequently they used various hiring tools during the interview process they responded with the following information provided in Table 6. The scale and question below were utilized for this portion of the survey.

1-----2-----3-----4-----5-----6-----7

Very Little Use Moderate Use Very Heavy Use

How frequently do you use the following tools when hiring for this project function?

Table 6. Hiring Tools for Interviewing Applicants

Tools	Mean / Median
Unstructured Interviews	5.5 / 6.0
Structured Interviews	4.5 / 5.0
Formal Records Review	3.4 / 3.0
Personality Tests	2.0 / 1.0
Skills & Abilities Tests	1.9 / 1.0

The ANOVA test yielded a p-value of 0.0002 and the results of the confidence interval test demonstrated that a significant difference occurred between the Unstructured and Structured Interviews and the Personality, Skills and Abilities Tests. It is apparent that contractor companies are tending to hire applicants based on interviews without applying any additional focus to skills and personality tests which might possibly be utilized to further address the applicant's ability to work in collaborative relationships.

4.5 PERSONALITY TRAITS FOR HIRING

Regardless, of the methods of hiring or what background the applicants brought forth during the hiring and interview process it was important to look at what personality traits companies felt were important. Therefore, the survey further requested information on specific personality traits, if any, companies assessed when hiring. When asked the following question below they utilized the personality traits listed in Table 7, as a source for possible responses:

Indicate whether or not you formally screen prospective applicants for the following personality traits.

Table 7. Traits to Consider during Selection of Owner Personnel

Source: (Davis-Blake et al.1999)

Trait	Definition
Agreeableness	Ability to get along with others and be open minded to new ideas.
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.
Conscientiousness	Perseverance, responsibility, and thoroughness in completing task.
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.

All the respondents in some form or fashion utilized at least one of the personality traits when hiring new applicants for specified project functions. Figure 2 reflects the percentage, with the highest percentage reflecting most utilized, with regard to most important personality traits.

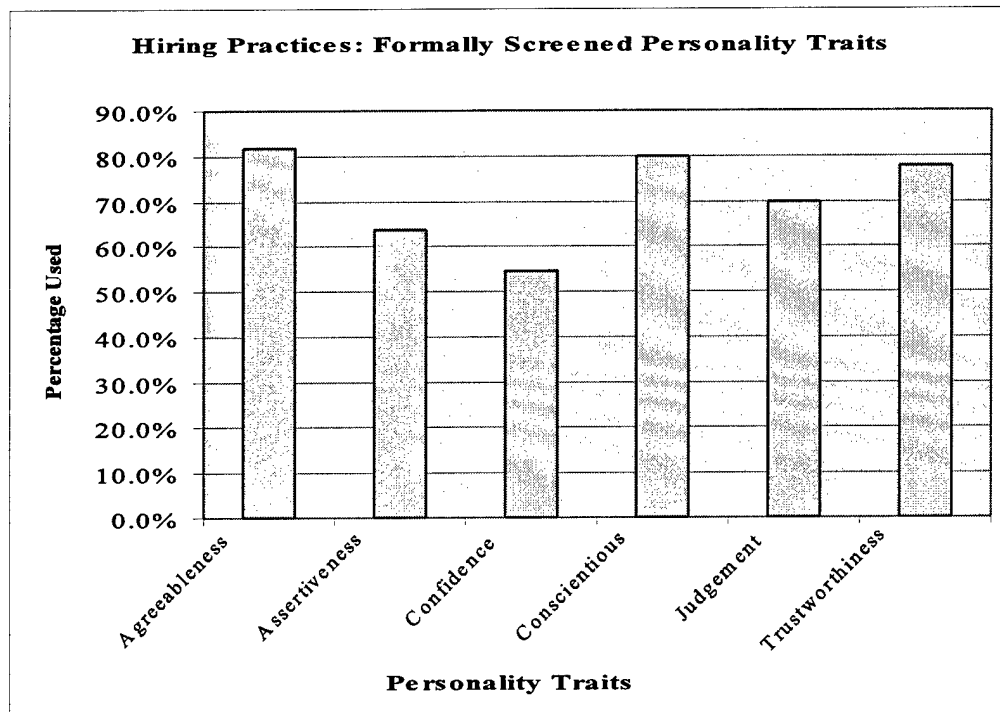


Figure 2. Traits to Consider during Selection of Contractor Personnel

The ANOVA test for this section of the survey resulted in a p-value of 0.79 and therefore, we could not reject the null hypothesis. This indicates that the means of the sub-samples are equal and therefore, do not demonstrate a statistically significant difference between the personality traits. However, it should be noted that the traits important to fostering and developing stronger collaborative relationships (Agreeableness, Conscientiousness, and Trustworthiness) are being utilized more often than the other three “individual” traits, but still, no formal method of employment or method of rating these traits are being utilized during the hiring process.

4.6 PERFORMANCE APPRAISALS

When analyzing current performance appraisal practices for the respondents the survey asked the following two questions.

What percentages of the employees currently receive annual performance appraisals?

What percentage of the employees have their annual appraisal used to determine compensation?

For employees who receive annual performance appraisals, it was found that 81 percent of the respondents utilized annual performance appraisals. However, it should be noted that the median value for this question was 100 percent, had a range of 0 percent to 100 percent, and a standard deviation of 39 percent.

For the second question, 73 percent of the respondents utilized annual performance appraisals to determine the appropriate level of compensation. The range of responses varied from 0 percent to 100 percent, had a median of 100 percent, and a standard deviation of 47 percent.

Additionally, companies were asked to provide information on specific factors utilized during annual performance appraisals. The following list of

factors, in rank order, were provided by five of the eleven respondents. The list of specific factors used during annual performance appraisals are provided below.

In your company, what criteria are used to evaluate personnel in this project function?

- 1) Management Skill
- 2) Client Goals Attainment / Leadership / Communication
- 3) Team Work / Experience with Technical Skill / Quality / Quantity
of work / Professional Goals / Adaptability / Attitude / Creative /
Innovative / Initiative

For the performance appraisal criteria listed above those skills listed in 1) and 2) predominately represent skills required to develop and foster stronger collaborative relationships. However, as it will be seen in the following sections of the survey it is in stark contrast to how employees are trained and paid.

4.7 TRAINING PRACTICES

When looking at the current contractor company training practices the question below and the list in Table 8 were utilized to determine how these contractor companies were dealing with meeting owner company requirements for a broader range of project management functions.

Indicate how much training personnel in this project function receive for the following skills during their first year on the job and annually thereafter (in days). If training is ongoing over a person's career, please estimate the number of days of training in a given year.

Table 8. Skills Required by Successful Owner Project Personnel

Source: (Davis-Blake et al.1999)

Category of Skills	Examples of Skills
Business Skills	Writing and managing contracts Negotiation Managing budgets and schedules
Communication Skills	Coordination/liaison Conflict management Cultivate broad network of relationships
Influence Skills	Mentoring Motivating Change management
Managerial Skills	Team building Delegating Politically aware/see big picture
Problem Solving Skills	Continually analyze options/innovation Planning Consider both sides of issues, risk management
Technical Skills	Understand entire construction process Multi-disciplined (knowledge of several areas of engineering) Information technology skills

The results of the survey question were broken into two separate graphs and the figures on the following page, Figure 3, New Contractor Training, and Figure 4, Annual Contractor Training provided the following information:

- Contractor companies are placing a significant amount of emphasis on technical training. Companies on average spent 14 days training new employees on technical skills versus the next closest which was less than two days on new business skills.
- For annual training, on average, no company provided more than one week of annual training in any skill category. Similarly, training for technical skills exceeded all other skills training by 100 percent; approximately four days of training to the next closest, two days of training for business and managerial skills.

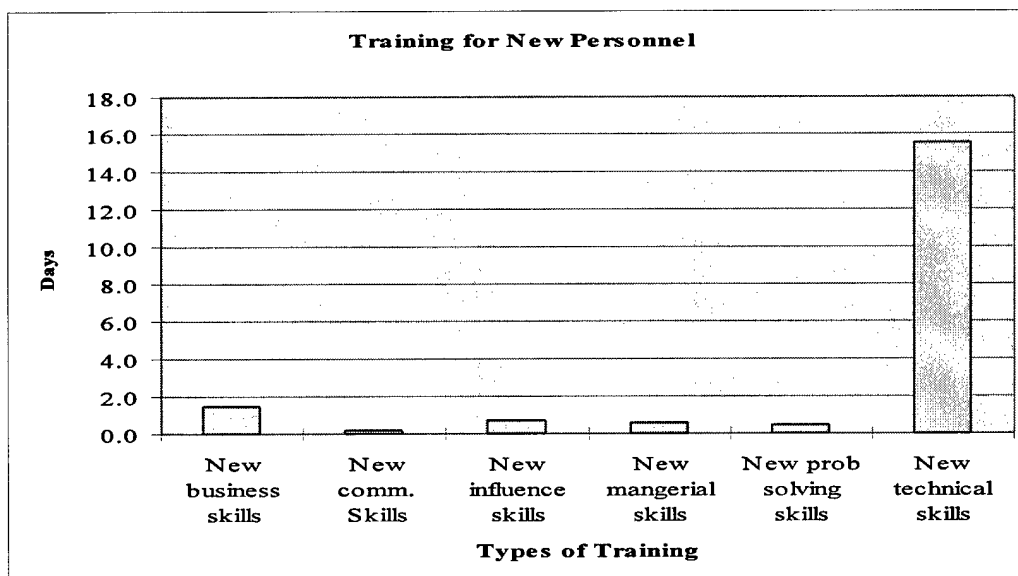


Figure 3. New Skills Training for Contractor Personnel

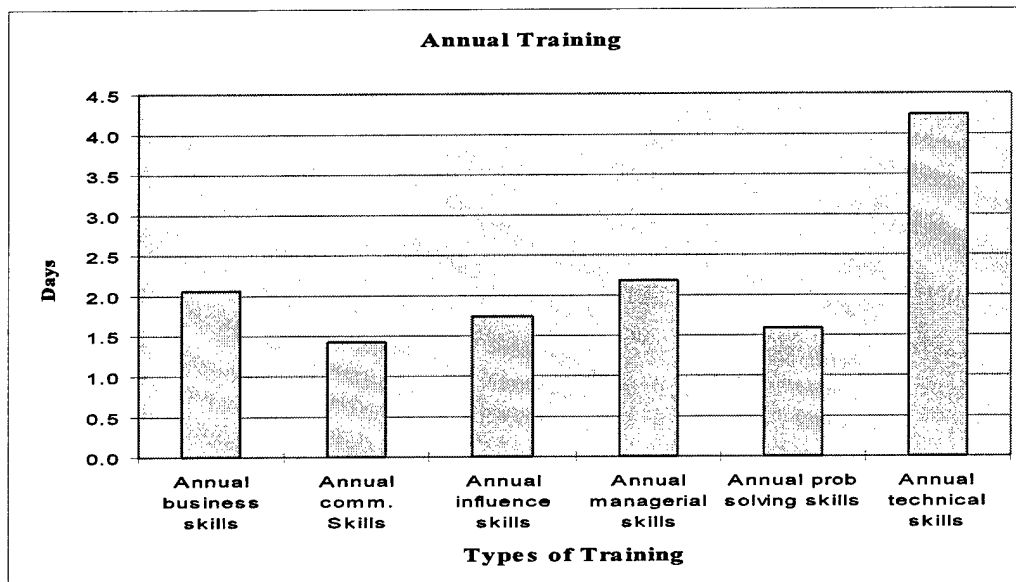


Figure 4. Annual Skills Training for Contractor Personnel

Companies are striving to improve their ability to meet owner requirements for additional skills needed by providing technical skills training. However, they are falling short on training new and current employees in those skills, designated by both owners and contractor companies, necessary to develop and maintain successful collaborative relationships.

4.8 COMPENSATION

For compensation purposes the survey analyzed what forms of compensation were presently being used for salary increases, and how it compared between project engineer and project manager. Additionally, the survey requested information for the level of importance when comparing the project engineer and project manager between business elements within the

company. The following information was gathered based on the questions listed below.

Which of the following forms of compensation are used for this project function? COLA; Merit Increase; Bonuses; Stock Options/Grants; Incentive Pay.

What percentage of pay for personnel in this project function is typically contingent on the factors listed below?

It was found unanimously among all eleven respondents that merit increases and bonuses were 100 percent utilized with less than 30 percent utilizing COLA and Incentives and less than 10 percent utilizing Stock Options.

For percentage of pay contingent on either corporate or individual goal attainment, it was apparent from the results presented in Table 9 that the current trend is to compensate project engineers and project managers based on individual performance on not on team factors.

Table 9. Performance Pay for Business Elements of Contractor Personnel

Business Elements	Project Manager	Project Engineer
Individual Performance	71%	85%
Project Performance	35%	19%
Office or SBU Performance	16%	34%
Corporate Performance	6%	3%

Additionally, when performing an ANOVA between business elements of the project management (PM) function and the project engineer (PE) function a p-value of 0.000 was recognized. Therefore, a difference in the means exists between at least one of the means (element). When further analyzed a significant difference existed between the PM individual performance and all other three business performance elements and the PE individual performance and the PE project and corporate performance element.

Interestingly, the results of this question highlight that contractor companies are still placing a significant amount of importance on individual success and performance rather than on the other three “team” elements. With such emphasis being placed on team work and the goal of fostering new and stronger collaborative relationships, it might be important for companies to look at how individuals performance compares to team performance and if compensation and rewards for performance of duties should be realigned.

4.9 CAREER PATHS

For career paths it became apparent that all the companies participating in the research study had different names for similar positions. At times a title name utilized by one company was one or two levels below or above another company title name. So, for purposes of comparison the researcher provided generic job titles to allow for an even comparison of career progression. Also, addressed in

this section was the percentage of internal hires working within each position. The following questions and Table 10 describe the results of current career progression within participating contractor companies.

Describe the typical sequence of jobs through which personnel in this project function progress.

Of the job titles listed above, what is the highest job title typically attained by personnel in this project function originally hired at the entry level?

Table 10. Job Progression and Percentage of Internal Hires

Job Title	Time at job title (Years) (mean / median)	% filled with internal hires (mean / median)
Level I	5.13 / 5.00	22.1% / 0%
Level II	5.00 / 3.50	77.2% / 80.0%
Level III	5.63 / 4.00	73.3% / 77.5%
Level IV	6.20 / 7.00	76.3% / 77.5%
Level V	5.33 / 5.00	85.0% / 90.0%

The amount of time spent within each job title and the percentage of internal hires progressing through company lines was very consistent between the respondents. A significant increase in the percentage of internal hires filling company positions between Level I and Level II was noted and the likelihood of hiring within the company for entry level positions has sharply decreased over the

years. Additionally, the data, on average, demonstrates that greater than 73 percent and higher of those personnel attaining Level II to Level V were hired from within the company.

4.10 ORGANIZATIONAL DIVERSITY

Organizational diversity for age and gender are considered very important to the industry's future and was the subject of a past CCIS study (Davis-Blake et al. 2001).

Four points of the study that should be noted are as follows:

- Existing sources of new hires will be insufficient to replace departing employees and to support the level of growth desired by nearly all contractor firms.
- Contractor firms are faced with a loss of project engineering and professional expertise.
- Retention in contractor firms is not high.
- Sectors of the population; women/minorities are under represented.

Therefore, the survey addressed age distribution and percentage of gender (male) representation within each age group. The following question was asked.

Describe the distribution of this project job function by age and describe the distribution of each age factor by gender.

The various percentages for age groups (10 year increments) and for gender (male) breakdown can be found in Figure 5 and Figure 6, respectively.

Analysis of the question with regard to the age distribution presented a similar percentage breakdown when comparing the results of the CCIS Demographics Study (Davis-Blake et al. 2001). The following survey data was extracted:

- CCIS (2001), Age 39 years and under: 31% vs. 35% for this research
- CCIS (2001), Age 40 years to 59 years: 62% vs. 59% for this research
- CCIS (2001), Age 60 years and older: 7% vs. 5% for this research
- CCIS (2001), Age 40 years and older: 69% vs. 65% for this research

The results support previous work showing that contractor companies are not properly addressing the aging workforce and that the potential problem of the retiring workforce within this decade and the early part of the next decade will become significant.

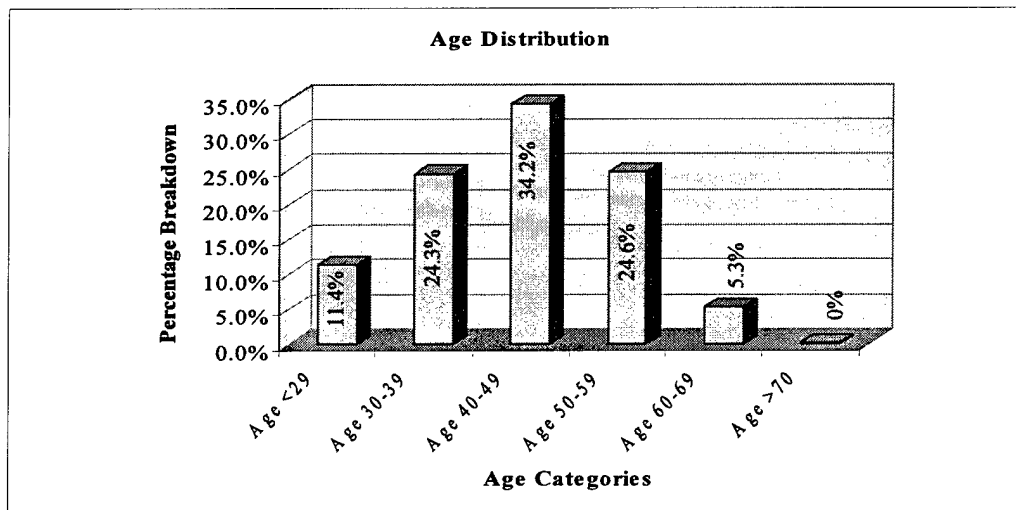


Figure 5. Age Distribution for Contractor Personnel

Interestingly, it was found in the analysis of gender distribution that for entry level personnel in this sample, women exceeded the approximate 9.0 percent work force representation found in CCIS (2001) with an approximate 26 percent representation. However, the percentage decreases significantly between the ages of 30 and 40 years and becomes nonexistent around 60 years of age; as shown in Figure 5.

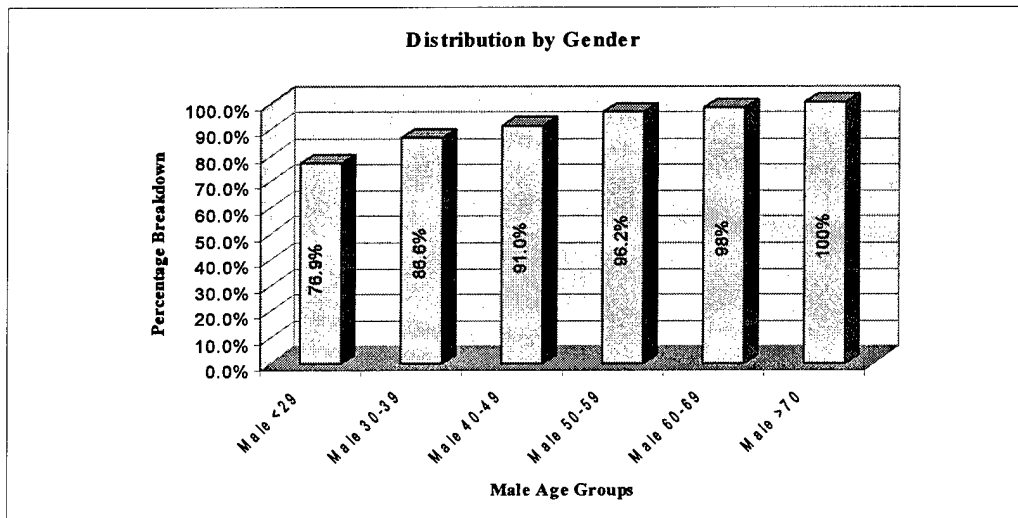


Figure 6. Percentage Distribution for Male Employees by Age

4.11 SUMMARY

As previously stated in the background chapter, the Phase II Owner Study found that owner personnel are unanimous in their view that changing owner-contractor relationships require owner personnel to have new skills (Davis-Blake et al. 1999). Additionally, it was found under CCIS, No. 11, Organizational Change Phase I Contractor study, that specific human resource issues are becoming increasingly relevant and need to be addressed (Gibson and Ryan 2000).

- Finding qualified individuals to meet the demands of the industry at all levels, from the trades through project managers, was cited as an industry issue.
- Availability of qualified senior personnel is becoming an issue.

- With the escalating workload, several participants expressed concern and frustration about their limited ability to mentor subordinates, further eroding the pool of qualified individuals.
- Entry level project staff will have different occupational status expectations than their predecessors. New employees lack the "I'll do anything attitude" of their predecessors

As these issues are being brought to light it is becoming ever more important that contractor companies adapt and change in order to succeed in today's industry.

Although a small sample the results of this HR survey provided some interesting results on how contractor's are currently hiring new employees, developing new skills, addressing age and gender within the workforce, and how these areas apply to the fostering new and stronger collaborative relationships. The findings of the survey are as follows:

- Experience and the ability to work with others generally outweigh education in choosing new employees.
- When hiring new personnel, structured and unstructured interviews are much more utilized over skills and personality tests.
- The higher percentage traits of "team work skills," agreeableness, conscientiousness, and trustworthiness, are being utilized more often than the other three "individual" traits of assertiveness,

confidence, and judgment. However, these traits are being assessed via interviews and without a formal method or process.

- Company appraisal practices for performance are in contrast to the training and compensation practices of their companies. Appraisals are management-, client-, and, team-based while training and compensation are based on technical skills and individual performance, respectively.
- A significant amount of new employee training and annual employee training is being provided to employees. Less emphasis is being placed on business, management, communication, and problem solving skills training.
- All respondents indicated that merit increases and bonuses were utilized for salary compensation purposes, however, COLA and Stock Options were utilized less than 30 percent of the time.
- Contractor companies are placing a significant amount of importance on individual success and performance over team, and corporate performance.
- The amount of time spent within each job title was around five to six years and the percentage of internal hires progressing through company lines was very consistent at around 70 plus percent.

- Entry level employees, Level I, are being hired from outside the company while subsequent follow on positions, Level II and above, are generally hired from within the company.
- The aging workforce is very similar to the previous CCIS study and will cause problems in the near future.
- Male gender distribution for entry level personnel has dropped since the last CCIS study (Davis-Blake et al. 2001). Women exceeded the approximate 9 percent work force with a 26 percent representation in entry level positions shown in previous reports (Davis Blake et al. 2001). However, the percentage reduces significantly between the ages of 30 and 40 years and becomes nonexistent around 60 years of age.

In conclusion, the findings as related above are very similar to past studies of owner organizations conducted by CCIS. The issues seem to cut across both the owner and contractor community.

Chapter 5: Analysis of Management & Project Manager Surveys

5.1 OVERVIEW OF MANAGEMENT AND PROJECT MANAGER SURVEYS

The purpose of the Management and Project Manager survey's were to analyze current operating practices within contractor companies and provide feedback on the latest trends emerging within the industry from the contractor's perspective. Because they focused on the same sample of projects, they will be analyzed concurrently in this chapter. Additionally, the surveys provided information on the collaborative relationships that exist between design, engineering, and construction management contractors and owner or the construction of capital facility projects. A complete list of participating companies can be found in Appendix A, an example of the Management survey is provided in Appendix C and an example of the Project Manager's survey can be found in Appendix D of this thesis.

As previously described, the standard baseline project for which the surveys requested information established the following guidelines:

- Projects are either above average or below average for performance.
- Completed during the period of 1995-1999
- Domestic location within the United States

- Over \$2 million total project cost (No dollar amount was specified for the project management survey)
- Primary manager is employed by your company
- Management - Project was executed for an owner organization with which you have a formal or informal collaborative relationship.
- Project Manager – Project was executed for an owner organization with which you have either a collaborative or non-collaborative relationship.

5.1.1 Sample Survey Data

The sample for the Management and Project Manager survey's consisted of 16 companies resulting in responses (sample surveys) from nine and 40 respondents, respectively. Each of the Management and Project Manager survey respondents, were asked to provide information on one to four projects. The nine total management surveys yielded data from 28 projects and the project manager surveys resulted in 40 projects. Therefore, for each of the sections within Chapter 5, when differentiating between sample size of figures and tables for overall, collaborative, and non-collaborative relationships, it might be possible for some sub-samples to include more or less than the total sample size of the survey numbers listed above.

5.2 OVERALL OWNER-CONTRACTOR RELATIONSHIP

As previously utilized under the Owner-Contractor Organizational Changes Study, five types of possible collaborative relationships exist (Davis-Blake et al. 1999). The five levels, and their collaborative relationships, described in Table 11 demonstrate models of contractor involvement, along a relationship continuum, with the owner. One extreme is noted when the owner and the contractor have a formal document providing terms for a highly specified alliance that is agreed upon and managed at fairly high levels in both firms. Such an alliance specifies many features of the owner-contractor relationship including mechanisms for sharing information about future construction needs with the contractor, methods for allocating work between different contractors, and payment and incentive plans that apply across projects. At the other end of the continuum, the contractor forms a relationship with the owner via a winning bid or first use. Typically, forms of these contracts are executed under the low bid premise. The intermediate form of owner-contractor relationships are classified as being the preferred provider. Under this method the owner tends to work with the same small number of contractors over time, thereby working to develop good relationships with those contractors. However, this type of relationship does not bind the owner to future obligations with any other of the contractors.

For the purposes of this research collaborative relationships will encompass the categories of formal alliance, informal alliance, and preferred

provider. Non-collaborative relationships will entail winning bid and first use categories.

Table 11. Possible Owner-Contractor Relationships

Relationship	Description
Collaborative	
Formal Alliance	You and the owner have an alliance with written terms and conditions.
Informal Alliance	The owner is considered an alliance partner but no written agreement exists.
Preferred Provider	Your organization is a first choice contractor, but there is no alliance.
Non-Collaborative	
Winning Bid	No special relationship.
First Use	No previous relationship.

In each of the two surveys for management and project managers three, questions were asked to determine the following: the current type of relationship, whether the relationship with this owner has changed over time and if so, what was the relationship in the past. The three questions with associated data are presented below. Figures 7, 8, and 9 summarize the results of the question pertaining to the current relationship; Figures 10, 11, and 12 address if the relationship changed over time; and Figures 13, 14, and 15 address the relationship as it was in the past prior to the survey or current relationship.

What phase best describes the relationship between your employer and this project's owner organization?

When respondents for both the Management and Project Manager surveys were asked to provide project information it was based on "current" relationships. The following information from the surveys was provided:

The current relationships for management had 43 percent non-collaborative and 57 percent collaborative. Project manager data for current relationships with projects submitted under the title of "Current Collaborative Relationship" resulted in an 82 percent use of collaborative relationship categories vice a 16 percent usage of collaborative relationship categories used in "Current Non-collaborative Relationship." This confirms, somewhat, the internal consistency of these self-reported data.

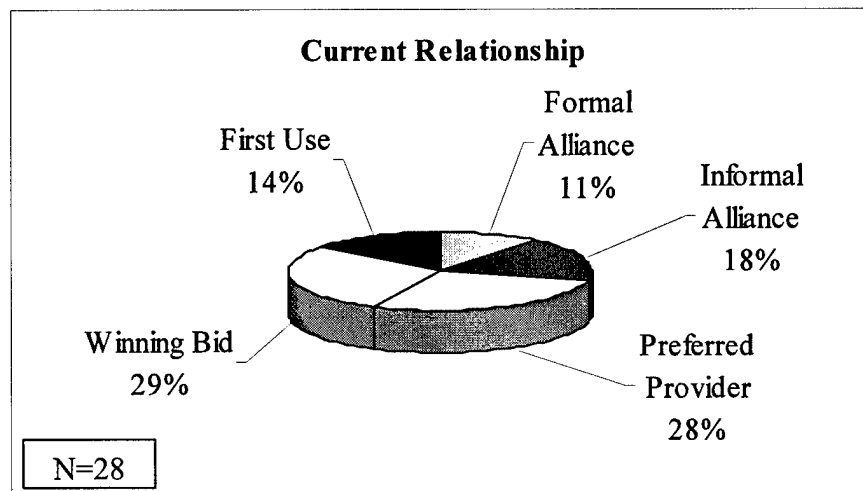
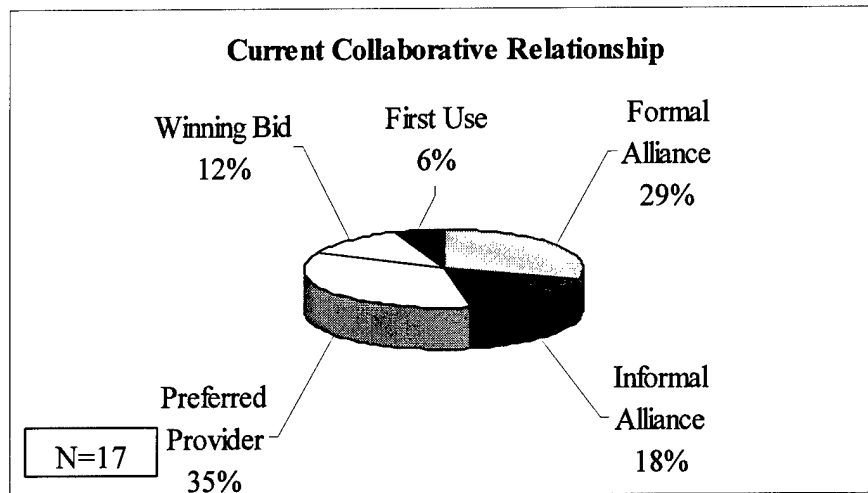
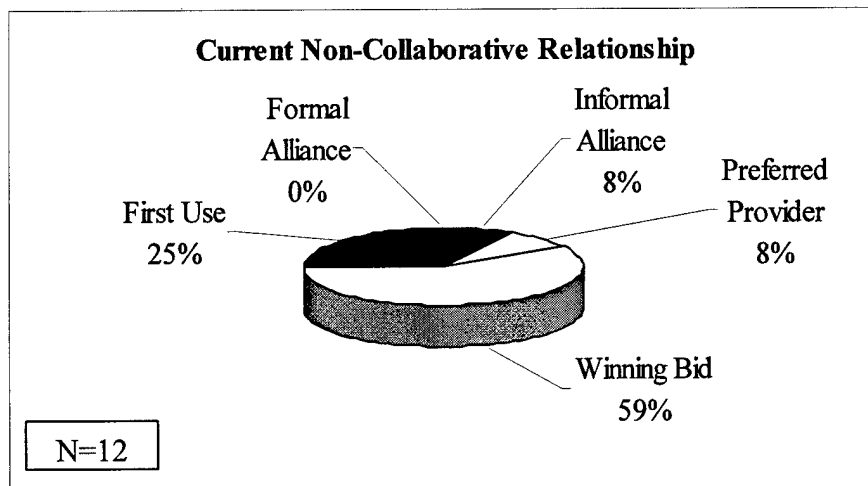


Figure 7. Management Survey: Current Owner-Contractor Relationship



**Figure 8. Project Manager Survey:
Current Owner-Contractor, Collaborative Relationship**



**Figure 9. Project Manager Survey:
Current Owner-Contractor, Non-Collaborative Relationship**

Has the nature of your relationship with this owner changed over time?

When addressing the question of “changed relationship,” for this subsample it was found that both the management and the project manager’s surveys had witnessed a relationship change from past relationships to current relationship.

Management (in their survey) had witnessed 56 percent of the “current” projects submitted shifting from a non-collaborative relationship to a collaborative relationship. Of the projects submitted under the project manager’s survey, 80 percent of either the collaborative or non-collaborative relationships witnessed a positive shift in the relationship continuum.

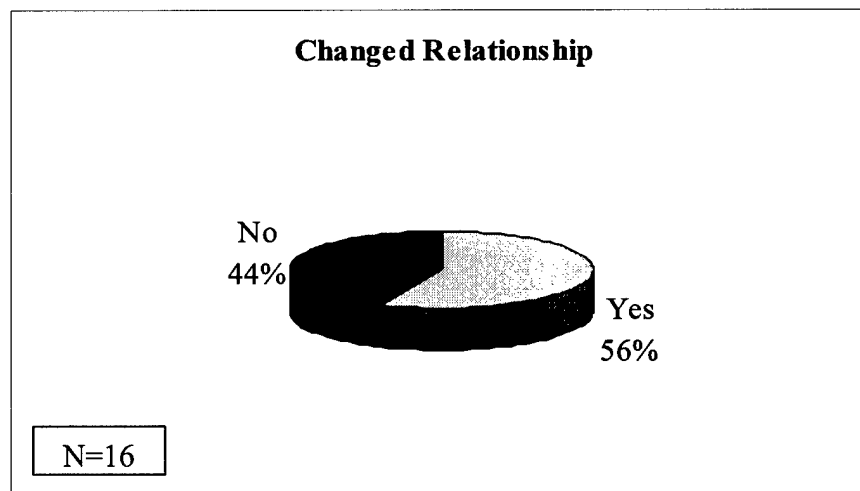


Figure 10. Management Survey: Changed Owner-Contractor Relationship

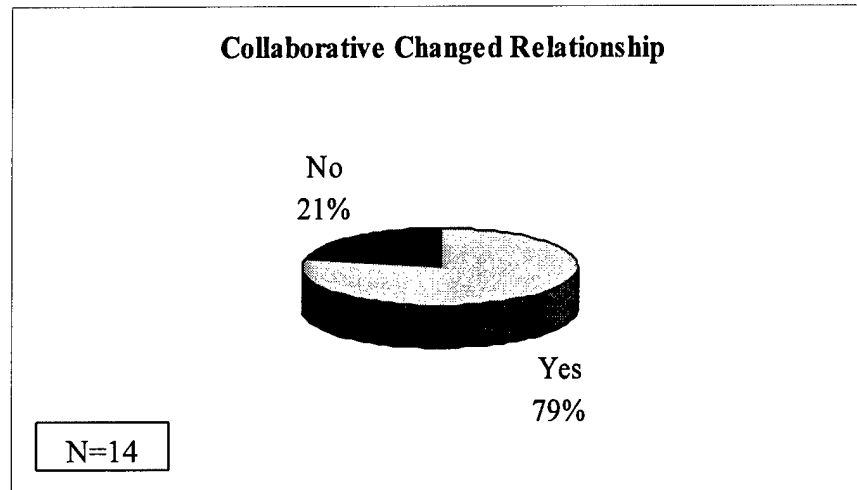


Figure 11. Project Manager Survey: Changed Owner-Contractor, Collaborative Relationship

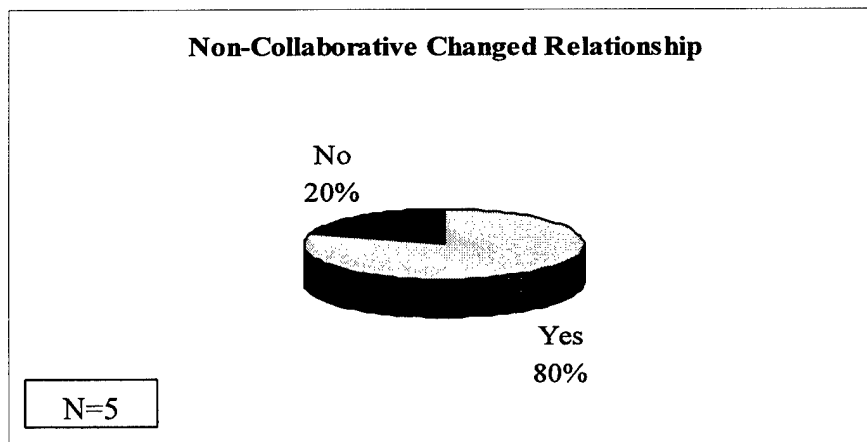


Figure 12. Project Manager Survey: Changed Owner-Contractor, Non-Collaborative Relationship

If so, what best describes the relationship in the past?

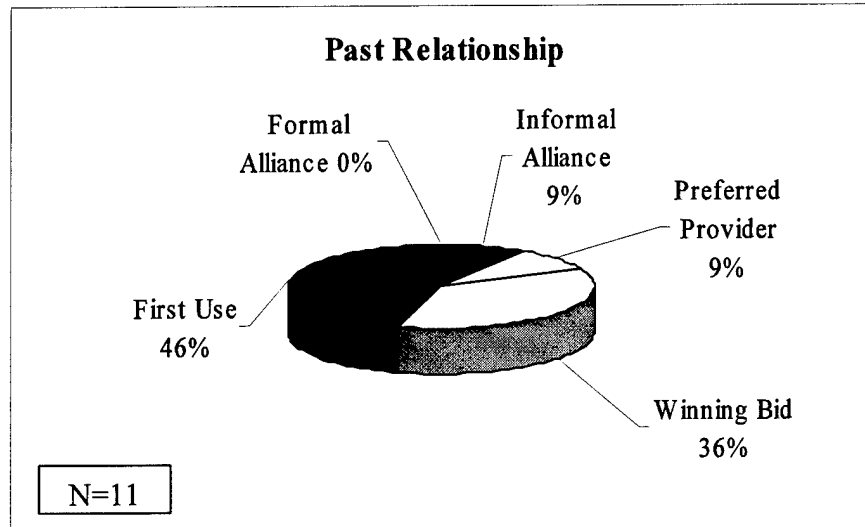
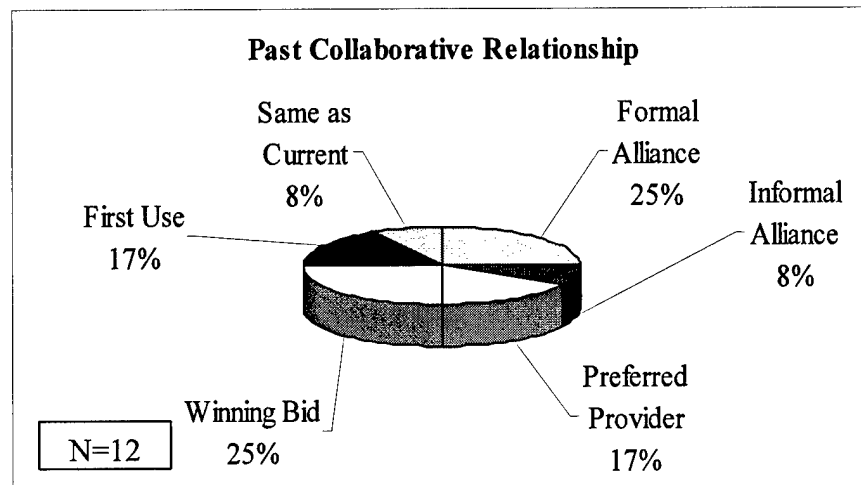
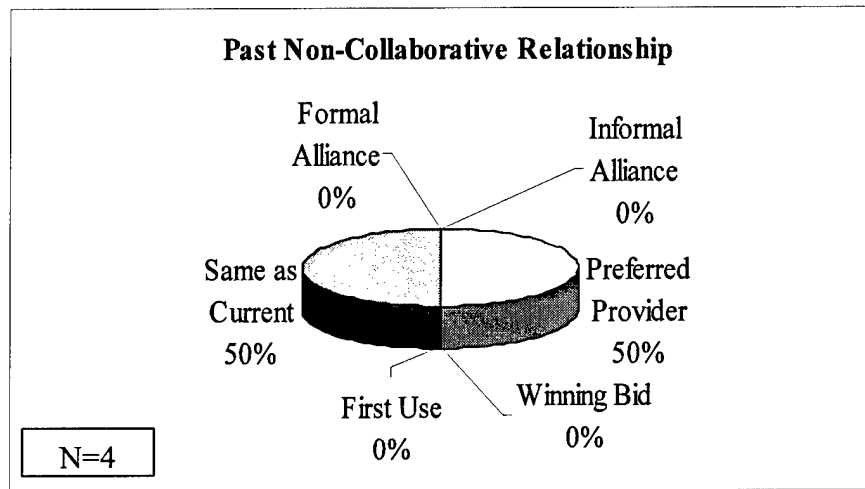


Figure 13. Management Survey: Past Owner-Contractor Relationship



**Figure 14. Project Manager Survey:
Past Owner-Contractor, Collaborative Relationship**



**Figure 15. Project Manager Survey:
Past Owner-Contractor, Non-Collaborative Relationship**

Data for Figures 7 through 15 suggests that working relationships over time have a natural tendency to progress towards positive working relationships.

- Management past collaborative relationship categories increased from a usage of 18 percent to a current collaborative relationship value of 57 percent.
- For project manager's the past collaborative relationship categories increased from a usage of 58 percent to a current collaborative relationship value of 82 percent.
- For the past non-collaborative relationship projects discussed, only four samples were provided and this significantly skewed the data, however, it should be noted that the relationship category either

remained the same, from past to current, or noticed a reduction in positive collaborative relationship categories from past to current working relationships.

Both the project managers and management demonstrated that over time when working with the same contractor, that if a collaborative relationship exists, it either started out as such or was fostered and had shifted to a more positive collaborative relationship. Were as, for projects currently in a non-collaborative relationship, if not worked on, the relationship was likely to remain in a non-collaborative relationship.

The shift from one end of the continuum to the other was in some cases highly significant and resulted in a positive working relationship. The collaborative working relationships shown in Figure 8 and Figure 14 provided the biggest gain when compared to the management and project manager non-collaborative relationship. Greater than a 32 percent gain was realized when moving from one continuum (First Use/Winning Bid) to the other (Alliance/Preferred Provider).

The ANOVA between the past and current samples for the management data resulted in a p-value of 0.02 and the past and current samples for the project manager's data had a p-value of 0.3259. This demonstrates that a significant difference between the past and current relationships for the Management survey

existed. However, for the Project Manager's survey it shows that the past and current samples are approximately equal and therefore, not significantly different.

Regardless, all three categories had witnessed a shift in one form or another from a non-collaborative nature to a more collaborative working relationship. Therefore, it is the opinion of this researcher that because of the shifting environment it is apparent that contractors are best served trying to foster stronger working ties with current and future owner companies.

5.3 OVERALL SUCCESS FOR MANAGEMENT & PROJECT MANAGER

To understand the overall success of the owner-contractor working relationship the respondents (Management and Project Manager survey's) were asked the following question and utilized the scale provided below:

Indicate the success of the working relationship with this owner firm on this project.

1-----	2-----	3-----	4-----	5-----	6-----	7
Not at all Successful		Moderately Successful		Very Successful		

The results from the management and project manager's perspectives are presented in Table 12 and Table 13, respectively.

**Table 12. Overall Success from Management Survey:
Collaborative and Non-Collaborative**

Collaborative				Non-Collaborative			
Category	Frequency	%	Rating	Category	Frequency	%	Rating
1	1	6%	Not at all successful	1	2	17%	Not at all successful
2	1	6%		2	2	17%	
3	0	0%	Moderately successful	3	0	0%	Moderately successful
4	5	31%		4	4	33%	
5	4	25%	Very successful	5	1	8%	Very successful
6	4	25%		6	3	25%	
7	1	6%		7	0	0%	
	16	100%			12	100%	

**Table 13. Overall Success from Project Manager Survey:
Collaborative and Non-Collaborative**

Collaborative				Non-Collaborative			
Category	Frequency	%	Rating	Category	Frequency	%	Rating
1	0	0%	Not at all successful	1	0	0%	Not at all successful
2	0	0%		2	2	14%	Moderately successful
3	1	6%	Moderately successful	3	1	7%	
4	3	18%		4	2	14%	Very successful
5	2	12%	Very successful	5	3	21%	
6	5	29%		6	5	36%	
7	6	35%		7	1	7%	
	17	100%			14	100%	

For the management surveys, the overall success mean and median response for the collaborative relationship, seen in Table 12, was a 4.6 and 5.0, respectively. For the non-collaborative relationship, seen in Table 12, the mean and median were 3.8 and 4.0, respectively; these relationships did not demonstrate a significant difference statistically, as the ANOVA was found to have a p-value of 0.1861; note that the collaborative relationships appear to be slightly better.

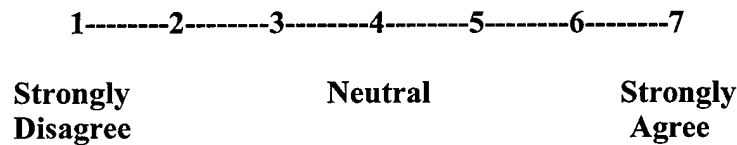
As for the project manager surveys, the collaborative relationship results seen in Table 13 were more optimistic. The collaborative relationship mean and median were a 5.7 and 6.0, respectively, and the non-collaborative relationship mean was 4.8 with a median value of 5.0. When the ANOVA was performed between the two samples the result was a p-value of 0.0865. Using a 95 percent level of significance, the results would lead one to accept the null hypothesis that the two sub-samples are equal and, therefore, not significantly different. However, with a value of 0.0865 and a stronger tendency of project managers to rate their projects "very successful" it is the opinion of the author that the use of a collaborative relationship affected the overall results of the final outcome of facility projects in this sample.

For both the Management and Project Manager surveys, the outright difference between the collaborative and non-collaborative nature of their relationships was very visible when the "overall success" of the project was asked. Therefore, for this sample, it appears that it would benefit contractor companies to invest in practices and processes which foster more collaborative relations.

5.4 OVERALL WORKING EXPERIENCE WITH THE OWNER

To understand the reasons why a contractor firm may or may not reach the goals and objectives of the owner firm, the following question was asked.

How well do the statements below describe your experience with this owner?



The results of the two surveys, Management and Project Manager, are provided in Table 14 and Table 15, respectively. The results of each table provide the mean and median values and are separated between collaborative and non-collaborative relationships. For these tables the bolded text values, from the author's perspective, are areas of interest and demonstrate a significant level of difference. Detailed discussions on the significance of the overall, collaborative, and non-collaborative relationships are at the end of this section.

Table 14. Management Survey: Overall Working Experience with Owner

Statements	Collaborative (n=16)	Non-Collaborative (n=12)
	Mean / Median	Mean / Median
We are the primary source of design, engineering and/or construction management services for this owner.	4.2 / 4.5	N/A
This owner is requesting that we supply a more diversified assortment of services.	3.7 / 4.0	N/A
Our organizational cultures are strongly aligned.	3.9 / 4.0	2.7 / 2.0
We entered our relationship with a strong-shared vision.	4.6 / 4.5	3.7 / 4.0
We meet regularly to address emerging issues.		4.2 / 5.0
We defined specific goal for our relationship.		3.9 / 4.5
The owner actively participates in the capital facility project process.	5.6 / 6.0	4.2 / 5.0
We evaluate our relationship performance against our goals on a regular basis.	4.5 / 4.5	3.8 / 4.0
We focus on learning and continuous improvement.	4.2 / 4.5	3.7 / 4.0
The owner understands the capital facility project design and construction process.	4.4 / 4.5	3.8 / 4.0
The owner provides positive feedback on our performance on regular basis.	4.6 / 5.0	3.2 / 3.0
There is a budget set up to cover the internal costs of maintaining and developing this owner relationship.	2.8 / 3.0	N/A

Table 15. Project Manager Survey: Overall Working Experience with Owner

Statements	Collaborative	Non-Collaborative
	(n=21) Mean / Median	(n=15) Mean / Median
We are the primary source of design, engineering and/or construction management services for this owner.	4.7 / 5.0	3.3 / 2.0
This owner is requesting that we supply a more diversified assortment of services.	4.1 / 5.0	2.5 / 2.0
Our organizational cultures are strongly aligned.	4.5 / 5.0	3.5 / 4.0
We entered our relationship with a strong-shared vision.	5.8 / 6.0	4.3 / 4.0
We meet regularly to address emerging issues.	5.4 / 6.0	5.3 / 5.0
We defined specific goal for our relationship.	5.6 / 6.0	4.6 / 5.0
The owner actively participates in the capital facility project process.	5.8 / 6.0	4.8 / 5.0
We evaluate our relationship performance against our goals on a regular basis.	5.0 / 5.0	3.1 / 2.0
We focus on learning and continuous improvement.	5.2 / 5.0	4.1 / 4.0
The owner understands the capital facility project design and construction process.	5.7 / 6.0	4.1 / 4.0
The owner provides positive feedback on our performance on regular basis.	5.6 / 6.0	3.9 / 4.0
There is a budget set up to cover the internal costs of maintaining and developing this owner relationship.	3.6 / 4.0	3.0 / 3.0

Table 14 and Table 15 present some interesting results. The overall analysis of the Management and Project Manager surveys, when looking at the data in its entirety exclusive of relationship, for each respondent group resulted in several statistically significant differences among the issues. The Management survey resulted in a p-value of 0.0038 and the Project Manager survey resulted in a p-value of 0.0000. However, the confidence interval test, utilizing Tukey's method did not provide additional insight as to which issues are statistically different.

Therefore, to further analyze the question, the author broke down each of the Management and Project Manager surveys by collaborative and non-collaborative relationships. Interestingly, the Management survey had values of 0.0004 and 0.4667, respectively and the Project Manager survey had values of 0.0000 and 0.0019, respectively.

For the collaborative and non-collaborative management relationships only the collaborative relationship demonstrated a significant difference when comparing the sub-sample means between the groups. As such, management was very adamant about their collaborative relationships. When the owner participates in the capital facility process, defines goals, shares a common vision with the contractor, meets regularly, and provides feedback then the relationship has a higher chance of being successful. However, money and time are not being invested by the owner to develop and maintain such relationships and it was found that owners and contractors cultures are still "misaligned." Additionally,

for the non-collaborative portion of the management question, similar results were found to be true and are presented in bolded text as well.

For both collaborative and non-collaborative project manager relationships a statistically significant difference occurred when comparing the sub-sample means between the groups of statements. The project manager's provided very similar results for this question when comparing between the two groups surveyed. Therefore, it could be said that the owners are doing the right things and contractors, regardless of the relationship, feel that both sides are working together once the project has started. It might be important to note that internal consistency exists for collaborative relationships. However, based on this sub-sample a place to invest more time and effort might be on learning processes, alignment of organizational cultures, continuous improvement practices, and additional funding towards fostering new and improved relationships.

5.5 OVERALL GENERAL ATTRIBUTES OF A SUCCESSFUL OWNER-CONTRACTOR RELATIONSHIP

As previously discussed, a successful relationship and a successful project are two different things (Davis-Blake et al. 1999). When owners were asked as to what attributes made for successful owner-contractor relationships a list of seven different attributes dominated their responses. To be consistent with what owners were asked and had provided, the survey asked each of the respondents to answer the following question:

Please rank the following list of relationship indicators based on their importance to the success of an owner-contractor relationship. (Using a scale of 1 to 7, where 1 is the most important and 7 is the least important.)

Table 16 represents the results from both the Management and Project Manager surveys and ranks the information in order of importance from highest importance to lowest importance. Note the consistencies for the areas between the most important and least important. Additionally, note the difference between the results for “operating for mutual benefit.” See Table 16 on the next page.

Table 16. General Attributes of a Successful Owner-Contractor Relationship: The Contractor Perspective

Source: (Davis-Blake et al.1999)

Attributes	Definition	Management (n=7)	PM (n=26)
		Mean / Median	Mean / Median
Contractor meets owner's project objectives	The project is delivered on or ahead of schedule and budget targets with minimal rework in the field. Startup is smooth.	1.7 / 1.0	1.5 / 1.0
Contractor responsiveness to changing conditions	Contractor responds quickly and effectively to owner needs. Contractor informs owner as early as possible about upcoming difficulties	2.7 / 3.0	2.5 / 2.0
Operating for mutual benefit	The relationship benefits both owner and contractor. Gains made through a productive relationship, such as cost savings, are shared between owner and contractor.	2.7 / 2.0	4.4 / 5.0
Contractor understands owner's business	Contractor personnel understand owner's business objectives and operating systems and procedures	3.7 / 3.0	3.3 / 3.0
Integration of owner and contractor personnel	Owner and contractor work together repeatedly, using many of the same personnel from project to project. Owner and contractor develop effective communication structures, a shared vocabulary, and a common project culture. Owner and contractor systems are integrated to the extent possible. Trust develops between owner and contractor personnel. Multiple levels of personnel are involved in both the owner and contractor organization	3.4 / 4.0	3.4 / 3.0
Contractor willingness to innovate	Contractor is willing to challenge owner ideas, recommend improvements, and take risks.	4.3 / 4.0	3.7 / 3.5
Learning from the relationship is documented and used	Owner and contractor explicitly discuss and document the lessons learned from each project. If possible, these lessons are integrated into systems and procedures that can be reused on subsequent projects.	5.4 / 6.0	5.0 / 5.5

When performing an analysis of variance, the Management survey subsample demonstrated a significant difference between the means of the attributes (p-value of 0.0113). The largest difference between the most important factor and least important factor for success between the owner and contractor was the ability to “meet the owner’s project objectives” and the ability to “learn from the relationship.”

In the Project Management survey, an ANOVA between the different factors resulted in a p-value of 0.0000 and, more significantly, was further separated by p-values of 0.0069 for collaborative relationships and 0.0000 for non-collaborative relationships. The most important factor, as ranked in Table 16, was the “contractor’s ability to meet owner’s project objectives” and the least important factor, once again, was the ability to “learn from the relationship.”

It should be of concern to contractor companies that “learning” is not of importance and “operating for mutual benefit” is not aligned with management’s objectives for ranking “operating for mutual benefit” higher. Some would consider both of these categories as very important in developing and maintaining successful collaborative relationships. Both could potentially pose problems if not addressed with: goal conflict in internal relationships, their ability to learn from the past, and in their ability to meet corporate objectives. Though more importantly, it is the opinion of the author that these two “least important” issues

should be addressed in an effort to improve or strengthen outside owner-contractor relationships.

5.6 SKILLS & TRAITS OF SUCCESSFUL OWNER-CONTRACTOR PERSONNEL

As was previously pointed out in Chapter 2.2.4, owner personnel have specific views of the skills and traits their personnel must have in order to be successful. For consistency within the CCIS work group, this research continued with the same list of skills and traits developed for owner organizations.

To analyze the skills and traits necessary for owner-contractor personnel from the contractor perspective the following question was asked:

Rank the following list of skills and traits based on their importance to the ability of: (Scale of 1 to 12, 1 is the most important and 12 is the least important.)

- Contractor personnel in key project position to successfully fulfill their duties and responsibilities?*
- Owner personnel in a key project position to successfully fulfill their duties and responsibilities?*

The results of the Management and Project Manager surveys are shown in Table 17 and Table 18, respectively. According to the author, bolded areas represent the most important and least important areas between sub-sample means, within each category, of owner and contractor groups.

Table 17. Management Survey: General Skills & Personality Traits of a Successful Owner-Contractor Relationship

Source: (Davis-Blake et al., 1999)

Skills & Traits	Definition	Contractor (n=7) Mean/Median	Owner (n=7) Mean/Median
Agreeableness	Ability to get along with others and be open minded to new ideas.	7.4 / 9.0	7.3 / 7.0
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.	8.7 / 10.0	8.7 / 10.0
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.	7.1 / 7.0	6.9 / 8.0
Conscientiousness	Perseverance, responsibility, and thoroughness in completing task.	5.7 / 8.0	6.7 / 7.0
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.	5.6 / 6.0	5.3 / 5.0
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.	4.0 / 3.0	4.3 / 4.0
Business Skills	Writing and managing contracts Negotiation Managing budgets and schedules	5.7 / 5.0	6.6 / 5.0
Communication Skills	Coordination/liaison Conflict management Cultivate broad network of relationships	3.6 / 3.0	3.1 / 2.0
Influence Skills	Mentoring Motivating Change management	10.2 / 11.0	8.3 / 8.5
Managerial Skills	Team building Delegating Politically aware/see big picture	4.1 / 4.0	3.3 / 2.0
Problem Solving Skills	Continually analyze options/innovation Planning Consider both sides of issues, risk management	4.6 / 4.0	4.4 / 4.0
Technical Skills	Understand entire construction process Multi-disciplined (knowledge of several areas of engineering) Information technology skills	4.7 / 2.0	8.3 / 10.0

Table 18. Project Manager Survey: General Skills & Traits of a Successful Owner-Contractor Relationship

Source: (Davis-Blake et al., 1999)

Skills & Traits	Definition	Contractor (n=26) Mean/Median	Owner (n=25) Mean/Median
Agreeableness	Ability to get along with others and be open minded to new ideas.	6.4 / 6.5	7.0 / 7.0
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.	7.3 / 9.0	7.4 / 8.0
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.	6.6 / 7.0	7.0 / 9.0
Conscientiousness	Perseverance, responsibility, and thoroughness in completing task.	4.8 / 4.0	6.2 / 7.0
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.	5.3 / 4.5	4.6 / 4.0
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.	3.5 / 2.0	3.1 / 2.0
Business Skills	Writing and managing contracts Negotiation Managing budgets and schedules	5.9 / 6.0	5.5 / 5.0
Communication Skills	Coordination/liaison Conflict management Cultivate broad network of relationships	4.6 / 5.0	4.2 / 3.0
Influence Skills	Mentoring Motivating Change management	6.9 / 7.0	7.1 / 6.5
Managerial Skills	Team building Delegating Politically aware/see big picture	4.3 / 4.0	4.6 / 3.5
Problem Solving Skills	Continually analyze options/innovation Planning Consider both sides of issues, risk management	5.0 / 4.0	5.4 / 4.0
Technical Skills	Understand entire construction process Multi-disciplined (knowledge of several areas of engineering) Information technology skills	4.1 / 3.0	6.0 / 6.0

When analyzing the Management survey, the ANOVA resulted in a p-value of 0.0086 for the owner and p-value of 0.0088 for the contractor. This demonstrates that there is at least one significant difference between the means. More specifically, it was found that for contractor personnel, a statistically significant difference occurred with trustworthiness and communication skills between the ability and skills necessary to influence. Additionally, in the opinion of the author, managerial skills should be included within the most important category and assertiveness should be included in the least important category. This is somewhat consistent with the emphasis placed on collaborative relationships, however, as previously stated in the HR portion of the survey very little training is being provided towards the development of communication skills (verbal or written) and management skills.

Additionally, the ANOVA for the Project Manager survey resulted in a p-value of 0.0000 and therefore, results in at least one of the sub-samples being statistically different from one of the other means. However, no statistically significant difference occurred as a result of the Tukey method test of confidence intervals. Regardless, it is the opinion of the author, based on this sub-sample, that similar results occurred between the owner studies and this research, and that both owners and contractors need similar sets of skills for either group to succeed. Therefore, project managers were fairly consistent in that they felt that trustworthiness, communication skills, and management skills were the most

important and that influencing skills and the ability to be assertive were the least important.

An additional point should be noted, that the largest difference between the owner and contractor mean values occurred in the technical skills categories. This should come as no surprise since the results of this question are consistent with the owner's desire to procure technical services by outsourcing and the contractor's desire to keep owner personnel away from technical issues.

5.7 MANAGEMENT SPECIFIC SURVEY RESULTS

The next section provides results of questions asked specifically on the Management survey and not asked in the Project Manager survey.

5.7.1 Employer Benefits from Management Perspective

The following question was asked of management to demonstrate why it is important foster a positive working relationship in an effort to move towards a productive collaborative relationship.

What are the benefits to your employer of this owner organization relationship? Rank in order of importance, #1 most important.

Referring back to section 5.2, Overall Owner-Contractor Relationships, it was found from the management perspective that a shift from past to current relationships, i.e. winning bid-first use to a preferred provider-alliance, had occurred. Table 19 lists the most important benefits and how they compare to one another.

Table 19. Employer Benefits of Owner-Contractor Relationship

Benefits	Mean / Median (n=16)
Early involvement in pre-project planning.	2.8 / 1.5
Improved ability to match owner's needs with level of service provided.	2.7 / 2.0
Improved project performance	3.6 / 2.5
Consistent flow of work	4.1 / 4.0
Timely identification and resolution of problems	4.5 / 4.5
Improved communications	4.7 / 3.5
Improved exchange of business and project information	5.0 / 4.0
Reduction in business development costs	5.1 / 5.0
Timely decisions	6.1 / 6.0

The ANOVA resulted in a p-value of 0.0342 and therefore, demonstrates a significant difference between at least one of the means within the groups.

However, the 95 percent confidence interval did not return any significant difference but a 90 percent confidence interval resulted in a significant difference between “Early involvement in pre-project planning and ability to match owner’s needs” with “Timely decisions.” Therefore, it could be said that timely decisions from the contractor’s perspective are not as important as the contractor’s ability to participate in pre-project planning and the ability to match owner’s needs. It is the opinion of the author that if companies focus attention on developing better collaborative relationships and work towards bettering non-collaborative relationships, then the ability to work on such “benefits” are more likely.

5.7.2 Future Investments from Management Perspective

Additionally, when management respondents were asked the question below the results tabulated in Figure 16 were found.

Based on the results of the project, I would like to make investments in the following practices (either create or improve existing practices) to create a closer working relationship with this owner organization.

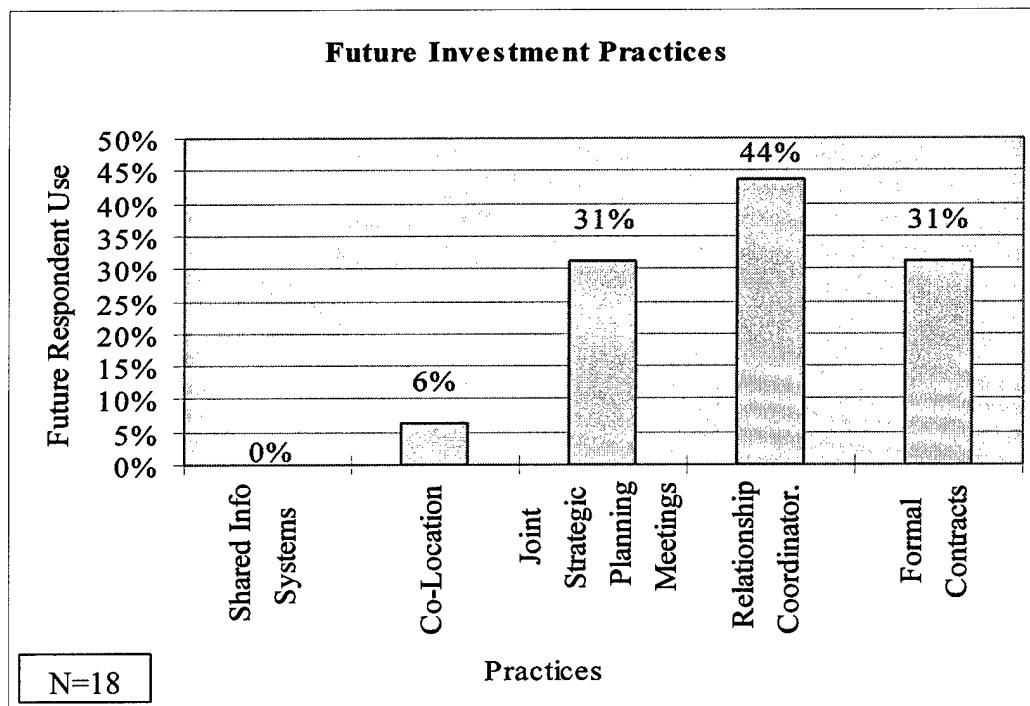


Figure 16. Future Contractor Investment Practices

The results provided in Figure 16, should be considered with the results from Section 5.2, Overall Owner-Contractor Relationships: Management Perspective. Of all the possible investment practices, the most important (highest percentage) of possible future investment practices was placed on utilizing a relationship coordinator. This would most likely be used to help maintain existing relationships and develop stronger ties with owner firms. This might be a possible reason for why past management relationships made a significant shift from “winning bid and first use” to the other, more positive relationships of the continuum. Note that contractor management placed less emphasis on joint

strategic meetings and contract development and all most zero emphasis on co-location and shared information technology.

5.8 PROJECT MANAGER'S SURVEY SPECIFIC RESULTS

The next section provides specific results of questions asked in the Project Manager survey and not asked in the Management survey.

5.8.1 Project Manager General Personal and Project Information

The information in this section was developed directly from the project manager's survey. Predominately the project manager's survey focused on information from a collaborative and non-collaborative relationship.

As previously addressed, it is very important to the success of a company to be able to develop and manage portfolios of business relationships. Additionally, collaborative relationships exist in business to achieve tangible results. So, it might further be explained that a collaborative relationship could be defined as a relationship between two or more organizations, much like a human relationships, and should be addressed and handled as a process. Therefore, for the purposes of this research and for the responses contained within this section, each of the project manager's responses were divided into two categories of either collaborative or non-collaborative relationships, as determined by each of the companies. With a reasonable amount of certainty it could be said that the collaborative relationships when compared to the non-collaborative relationships

had some form of formal or informal partnership or common bond between owner-contractor organizations.

Under this section personal project manager information and overall project information is provided.

For experience within the construction industry, amount of time spent with their current employers, and in their present title it was found that the project managers who worked in collaborative relationships had more years of experience in all three categories. Table 20 on the next page presents the information provided by all participating project managers.

Table 20. Project Manager Experience

	Industry Experience Mean / Median	Time Spent with Current Employer Mean / Median	Time Spent in Present Title Mean / Median
Collaborative, n=20	26.0 / 25.0	15.3 / 12.5	6.2 / 4.0
Non-Collaborative, n=16	22.3 / 20.5	16.5 / 15.5	4.2 / 3.0

Another question asked in the survey was asked to gain insight into the level of education the project managers participating in the survey have attained:

What degrees have been earned and in what year were they attained?

Figure 17 presents the data on highest degree attained by the survey's project managers. The range for such information provided was as early as 1964 and as recent as 1996. More importantly, it should be noted that over 90 percent of the project managers, regardless of the relationship, had degrees from sources of higher learning. This would signify a substantial change from decades past where the percentage of degree holding managers were vastly different from project manager of owner companies.

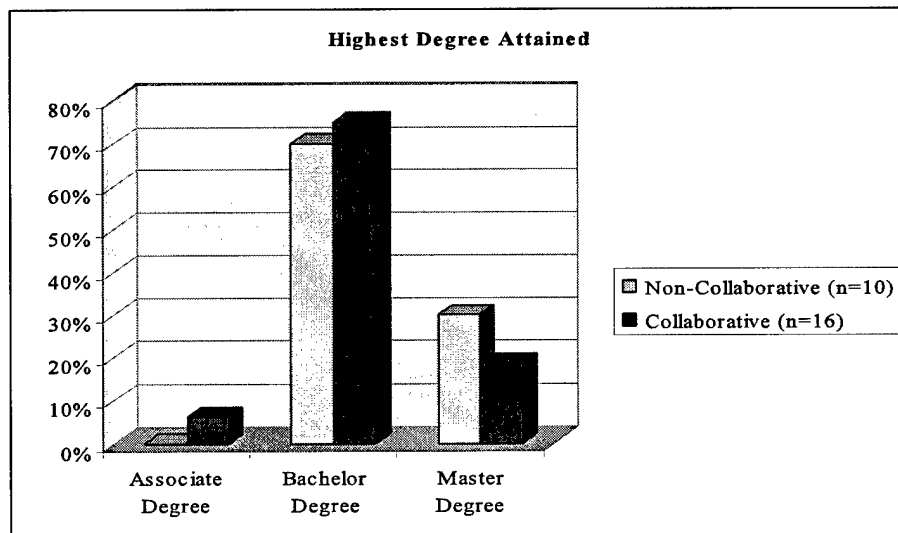


Figure 17. Project Manager Education: Collaborative vs. Non-Collaborative

The characteristics of the project sample, including types, location, level of difficulty, size, and execution processes are provided in Figures 18-22.

Approximately, 20 different project types were listed in the project management survey and the sample project breakdown is given in Figure 18. The type of facilities constructed and provided by the respondents ranged across the entire spectrum. Over 20 different categories of possible projects were provided, however, the ones listed in Figure 18 were provide as example projects. It is of particular interest that the "other" category had the most projects and such project submitted under the category were a nuclear plant, a hospital, a cinema and various other manufacturing plants not otherwise listed.

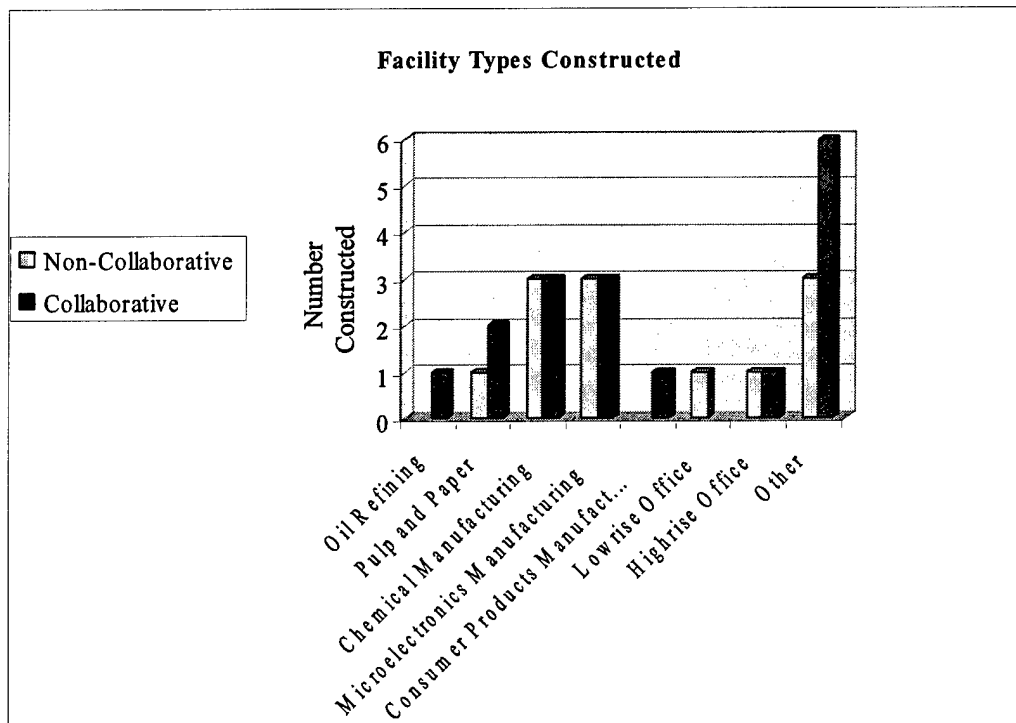


Figure 18. Project Manager: Types of Facilities

Additionally, it should be noted that facilities provided by the respondents spanned the United States and were constructed in the following locations: California, Georgia, Florida, Illinois, Indiana, Kentucky, Nevada, New Jersey North Carolina, New York, Ohio, Tennessee, and Texas.

As for project size, in dollars, of the capital facility projects executed under either a collaborative or non-collaborative relationships the following information was provided:

- Collaborative, (n=17): The average project size was \$ 43.8M with a median of \$ 26.2M and a standard deviation of \$ 51.3M. The range was: \$40,000 to \$212,000,000.
- Non-Collaborative, (n=13): The average project size was \$ 95.3M with a median of \$ 25.5M and a standard deviation of \$ 238.9M. The range was: \$188,470 to \$884,000,000.

One may infer that because of the high dollar amount and large standard deviation between the projects that this might be a reason for these projects being submitted under the non-collaborative relationships. However, the median for both project relationships are relatively the same, and a very large project of \$880M skewed the average and standard deviation for non-collaborative relationships. Therefore, it is the authors' opinion that the size of the project is not a determination for type of relationship or level of achieved success for this sample, but rather these factors are subject to other variables, possibly discussed later as a part of this research.

Also, it is important to understand how the projects were executed. It is common knowledge within the industry that retrofit/expansion projects are inherently more difficult to manage when compared to the typical "grass roots" projects and, therefore, it is understandable that more were executed under a collaborative nature. Additionally, it might also be said that the results of the survey have verified that more non-collaborative projects would be and were

executed under the “grass roots” type. Figure 19 is provided for a beak-out of “location” categories.

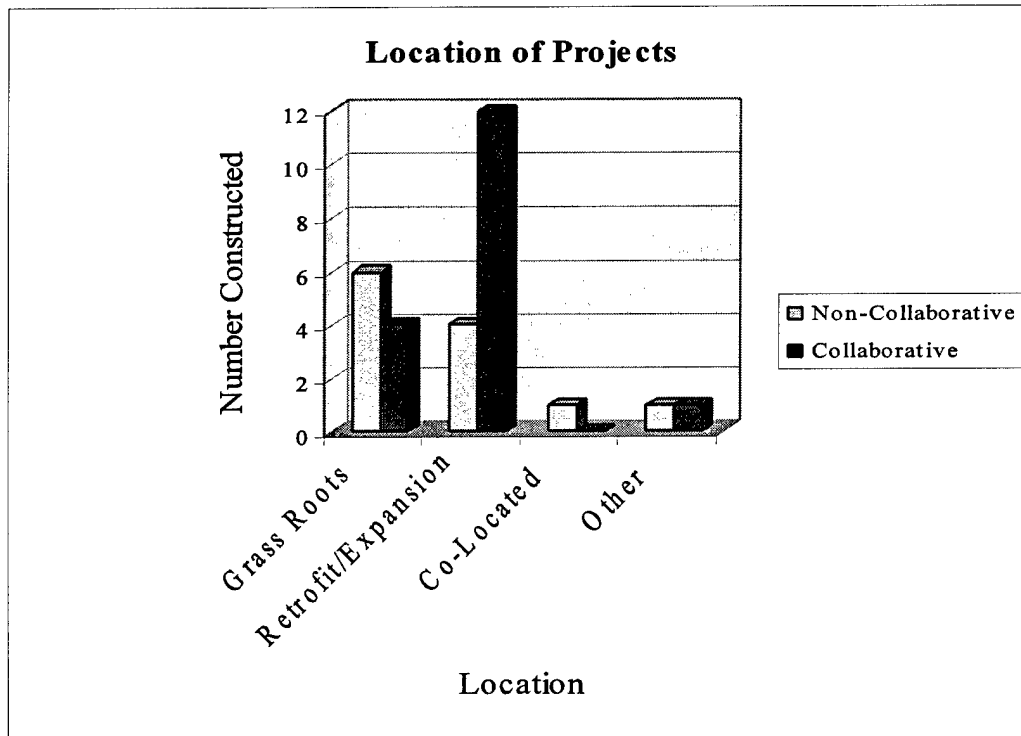


Figure 19. Project Manager: Project Site Location

Figure 20 shows the types of contracts utilized to construct the various types of facilities described. It should be noted, and will be discussed later in this section of the report, that for collaborative relationships a cost plus or multiple-combination “other” was utilized where as, for non-collaborative relationships, the predominately utilized remuneration was lump sum. It could be said from the results below that a collaborative relationship spreads (shares) risk between

the owner and contractor vice the lump sum contract mechanism which places a considerable amount of risk on the contractor.

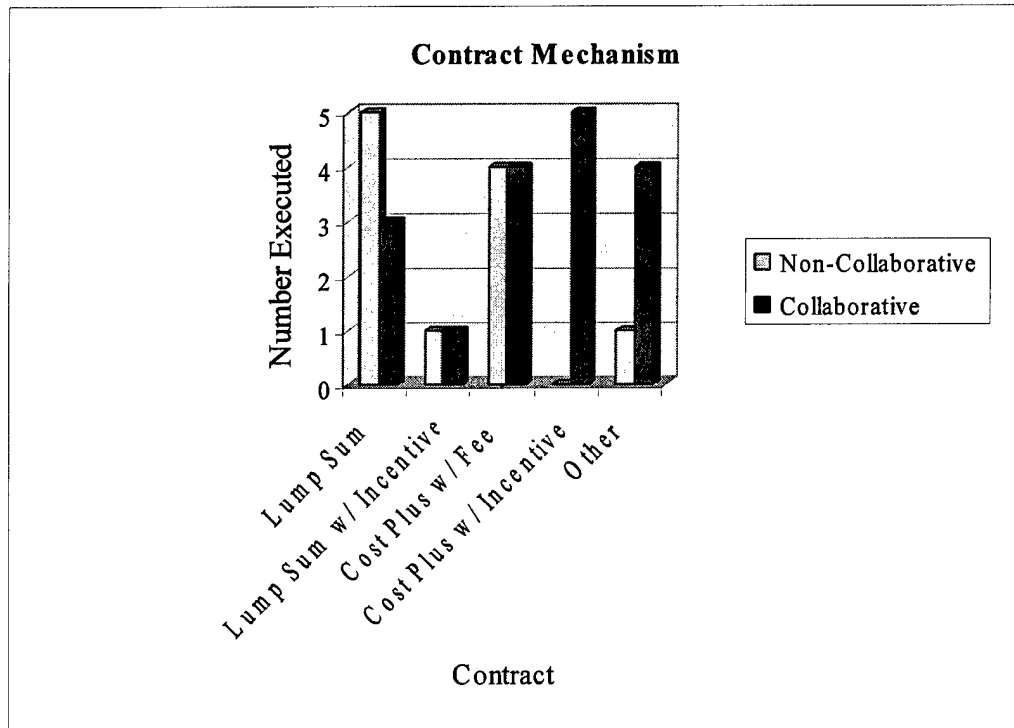


Figure 20. Project Manager: Type of Contract

In an attempt to gain additional insight into the level of project difficulty the project managers were asked to describe whether the project or execution process was unique to either the industry or company. As shown in Figure 21, nothing was unique for a majority of the projects. Therefore, when performing analysis of the project manager data, unfamiliarity with the project management and execution process should not be an issue when assessing success.

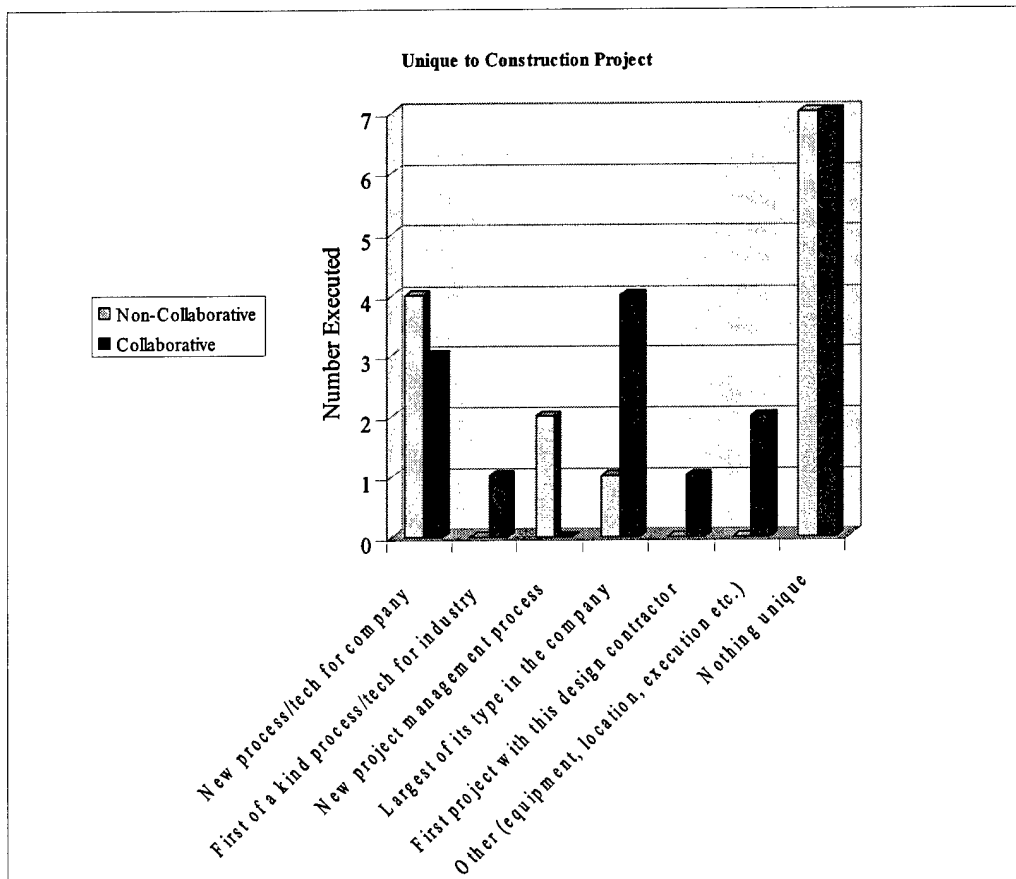


Figure 21. Project Manager: Unique Project Execution Practices

When describing how the sample projects were executed, utilizing either one or multiple contractors under numerous contracts, the non-collaborative relationship typically utilized “separate” contracts to complete a facility whereas, the collaborative relationship utilized both the single and separate contractor equally. Figure 22 demonstrates the type of execution plan and percentage used for each of the two types of relationships. The item of interest from the answers provided by the respondent project managers is that separate contractors,

designers and constructors, were used under non-collaborative relationships which would lead to less risk for the owner, and might possibly lead to a lower chance of success.

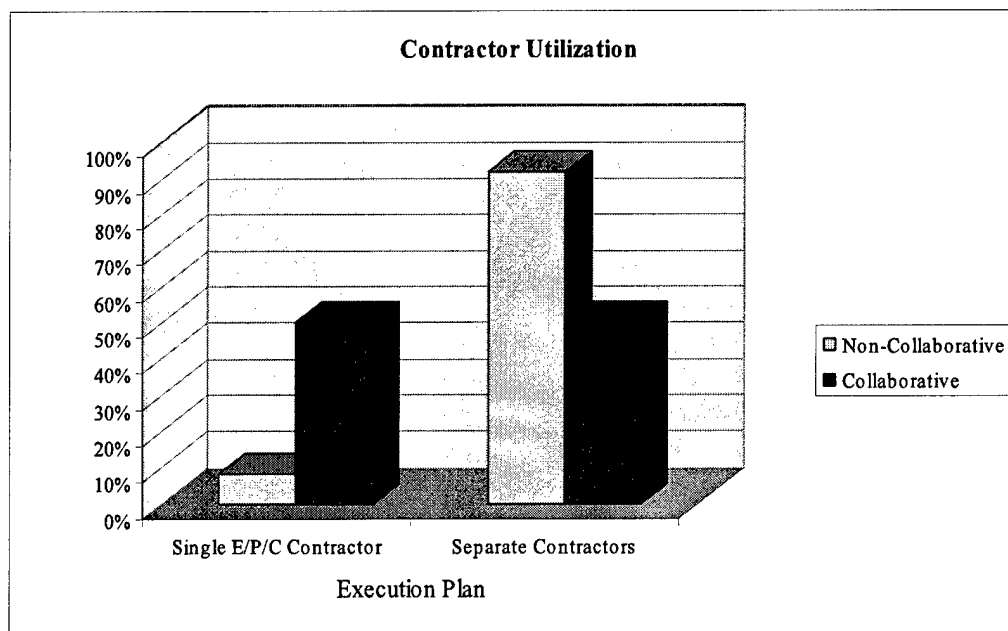


Figure 22. Contract Execution Plan: Single vs. Separate

5.8.2 Project Manager Expectations

Project manager expectations might easily be considered similar to the question concerning "Overall Success." However, for this section the two questions utilized took into account cost and capacity as factors of success. Cost

data and change order data presented in Table 21 provide a baseline for future discussion purposes.

Table 21. Capital Facility Project Costs and Change Order Costs

	Collaborative Project Cost	Collaborative Change Orders	Non-Collaborative Project Cost	Non-Collaborative Change Orders
Count	17	17	13	14
Mean	\$ 43.8 M	\$ 3.22 M	\$ 95.3 M	\$ 1.85 M
Median	\$ 26.2 M	\$ 1.28 M	\$ 25.5 M	\$ 0.65 M
Standard Dev	\$ 51.3 M	\$ 3.98 M	\$ 238.9 M	\$ 2.52 M
Range	\$40K - \$212M		\$188K - \$884M	

When asked two questions based on expectations pertaining to “facility / final cost” and “capacity achieved,” the following results of the two questions were found.

The scale below was utilized for statistical analysis of these questions.

1-----2-----3-----4-----5-----6-----7

Much Worse As Much Better
Than Expected Expected Than Expected

Indicate how the completed facility (considering the final cost) compares against expectations.

Indicate how the achieved capacity of the completed facility compares against the expectations documented in the project execution plan.

The results of the means and medians for both the collaborative and non-collaborative relationships for achieving “expectations” were 5.4 and 5.0 and 4.8 and 4.0, respectively. The ANOVA, however, resulted in a p-value of 0.2589, and therefore, did not present a significant difference between the collaborative and non-collaborative relationship. Table 22 provides additional information concerning the percentages of how project managers met the owner’s expectations when considering final cost.

Table 22. Meeting Project Expectations: Collaborative vs. Non-Collaborative

Collaborative				Non-Collaborative			
Category	Frequency	%		Category	Frequency	%	
1	0	0%	Much Worse Than Expected	1	0	0%	Much Worse Than Expected
2	1	6%		2	0	0%	
3	0	0%	As Expected	3	1	8%	As Expected
4	3	18%		4	5	42%	
5	5	29%	Better Than Expected	5	2	17%	Better Than Expected
6	3	18%		6	3	25%	
7	5	29%		7	1	8%	
	17	100%			12	100%	

When looking at the capacity of the facility to “meet expectations documented in the project execution plan,” the results of the collaborative and non-collaborative relationships were once again very similar. The mean and median for the collaborative relationship was a 4.6 and 4.5, respectively, while the mean and median for the non-collaborative relationship was 4.4 and 4.5, respectively. The ANOVA for this question resulted in a p-value of .9613 and

therefore, did not demonstrate a significant difference between the two relationships.

Therefore, when using information provided in Table 21 and comparing with the data provided for both questions it becomes apparent that the “expectations” and “overall success” are two similar entities and that the size (cost) of the project and change order costs when answering a general “all-encompassing” question such as the one posed in this section might not be a factor in determining the “overall success” or “expectations” of a project. The mean cost for the collaborative relationship projects was 50 percent less than the non-collaborative relationships, but the collaborative relationships had a 100 percent higher cost for change orders. Regardless, of the cost data, the collaborative relationships were considered more successful, as a whole. Based on this sub-sample other factors are considered more important than final project cost or change order cost.

5.8.3 Importance of Project Related Issues

In an effort to determine the similarity between factors that owners consider important and that contractors consider important, the following question was asked. The scale below was used and results are shown in Table 23.

To what extent did you and the owner place similar level of importance on each of the following issues?

1-----2-----3-----4-----5-----6-----7

Not To Some To a
at All Extent Large Extent

Table 23. Project Manager Survey: Level of Importance for Project Specific Issues between Owner-Contractor Relationship

Project Issues	Mean / Median (n=37)
Project Cost	6.4 / 7.0
Project Deadlines	6.4 / 7.0
Quality of the completed project	6.2 / 6.0
Responding to changes in project schedule	5.6 / 6.0
Building an ongoing relationship	5.4 / 6.0
Responding to changes in project scope	5.2 / 6.0

Not surprisingly, the results placed project cost and project deadlines as the two most important owner-contractor project related issues. The overall ANOVA (p-value of 0.0000) for this question, regardless of collaborative and non-collaborative relationships, did demonstrate a significant difference between means within the project issues (annotated by the lightly and darkly shaded areas of Table 23). Specifically, “project cost” and “project deadlines” were significantly more important than “responding to changes in scope and schedule”

and “building an ongoing relationship.” Additionally, “building a quality project” was significantly more important than “building an ongoing relationship” and “responding to changes in scope.”

When separating and analyzing only the collaborative relationship: the ANOVA p-value was 0.0074 and resulted in a significant difference between “project cost,” “project deadlines,” and “building a quality project” with “responding to changes in scope.”

However, with the non-collaborative relationship the ANOVA had a p-value of 0.0006 and add “building an ongoing relationship” to the list of issues listed in the collaborative list as not significantly important.

An interesting point to note is that “building an ongoing relationship” was rated relatively low overall and not significant in the non-collaborative relationship. In previous sections of the thesis, respondents from both the management and project manager side had rated areas of communication, developing relationships, and having relationship coordinators as important. The results might be considered consistent if companies want to improve their relations with owners, then a shift to fostering better relationships needs to take place.

5.8.4 Project Processes

To control the outcome of capital facility projects various tools and project controls can be enacted to improve the owner-contractor chances of success. Therefore, to understand what contractors are currently employing on projects the survey asked the following question and utilized the scale provided below:

To what extent were the following processes used on this project?

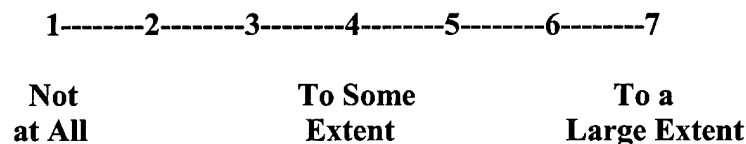


Table 24 shows the processes as they were presented to the project managers and ranks the data giving priority ranking to the collaborative data.

The ANOVA for both the collaborative and non-collaborative relationships resulted in p-values of 0.0106 and 0.0005, respectively. This demonstrated a significant level of difference between the means (bold areas).

When the collaborative data was further analyzed at a 95 percent confidence interval, the relationship had a significant difference between several of the means. Priority project processes for collaborative relationships were given to “long lead/equipment listings” and “documented change management

processes” with less emphasis being place on “formal vendor selection processes,” a “documented quality control program,” and over “resource loaded schedules.”

For the non-collaborative relationships, at the 95 percent confidence interval level, similar results were found that more significance to the processes of “long lead/equipment listings” and a “documented change management process” is more important over the processes of “vendor bid analysis,” “documented quality control program” and “resource loaded schedules.” One additional process of “bid analysis and award process” was included in the non-collaborative relationship that was not included for the collaborative relationship. This would account for the level of risk and trust involved in non-collaborative relationships.

Table 24. Project Manager Survey: Project Processes

Processes	Collaborative	Non-Collaborative
	(n=21) Mean / Median	(n=15) Mean / Median
Long lead/critical equipment listings were developed for this project and used in the procurement process.	6.4 / 6.0	6.0 / 6.0
A formally documented change management process was used to actively manage the changes on this project.	6.0 / 6.0	6.1 / 6.0
Clear, comprehensive and project specific material and equipment specifications were developed and incorporated into the procurement packages.	5.8 / 6.0	5.5 / 6.0
A constructibility review was performed with the design team.	5.8 / 6.0	4.7 / 6.0
A system was in place to ensure the timely communication of change information to the proper design disciplines and project participants.	5.5 / 6.0	5.4 / 6.0
Bid analysis and award processes were developed and actively applied to each bid package.	5.4 / 6.0	6.2 / 6.0
A formally documented materials management and tracking process was used to actively manage the procurement process on this project.	5.0 / 5.0	5.4 / 6.0
Formally documented vendor pre-qualification and selection criteria were developed and actively used in this project.	4.7 / 5.0	4.1 / 4.0
A formally documented quality control program was used to actively manage design quality on this project.	4.7 / 5.0	4.6 / 5.0
A resource loaded schedule for the design phase of this project was followed.	4.6 / 5.0	3.6 / 4.0

5.8.5 Project Stage Involvement

To acquire an idea about the level of involvement throughout the life cycle process of a capital facility project the project managers were asked the following question using the scale below. Table 25 demonstrates the findings.

During which stages of the project were personnel from your firm involved?

1-----2-----3-----4-----5-----6-----7
None Partial Full

When performing an ANOVA on the overall survey sample data for this question (p-value of 0.0000) a significant difference between full, partial, and no participation within the various stages of the life cycle process was demonstrated.

Additionally, it was found with a 95 percent level of confidence using Tukey's method that a significant level of difference of means occurred with full involvement of "construction," "procurement," and "start-up" and with relatively no involvement on "feasibility/business-planning," "pre-project planning," and "operation."

With the two planning stages of the life cycle process ranking at the bottom of the list for this section and first in section 5.7.1, Employer Benefits, it is the researcher's opinion that more emphasis needs to be placed on developing and

fostering positive working relationships. These should include early involvement in project and scope development and constructibility reviews of drawings and specifications. It should be noted that this question and the research study did not take into account the difference between design-bid-build and design-build projects. The bolded areas in Table 25 below reflect areas of significant difference between full participation and no participation.

Table 25. Project Manager Survey: Project Stage Involvement

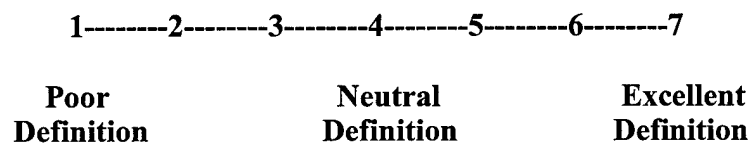
Project Stage	Mean / Median
<i>Construction</i> Building, including support required to install facility equipment/materials.	6.5 / 7.0
<i>Procurement</i> Planning and control to ensure the correct materials and installed equipment are specified in a timely manner, obtained at reasonable cost, and available when needed.	5.9 / 7.0
<i>Start-up</i> Period from mechanical completion of the project to operation or occupancy.	5.8 / 7.0
<i>Detailed design</i> The process of transferring the scope of the project into plans, material, and equipment specifications and drawings.	5.2 / 6.0
<i>Pre-project planning</i> Acquiring strategic information to address benefits and risks and commit resources that increase the chance of project success. Also, project site and technology selection and detailed project scope development.	3.8 / 4.0
<i>Feasibility analysis/business planning</i> The preparation of the conceptual project design, scope, cost estimates, and risk scenarios.	3.6 / 3.0
<i>Operation</i> Use of the facility for its intended purpose.	2.7 / 2.0

5.8.6 Pre-Project Planning

As outlined in earlier sections of the management and project manager's survey involvement in the earlier portions of the project (life cycle) might positively impact the successful outcome of a capital facility project. Therefore, project managers were asked to respond to three sets of questions pertaining to pre-project planning. The first two are listed below and the third pertained to a scale to define a list of technical and business elements which make project definition more complete and the outcome of a project more successful.

1. *Quality of the pre-project plan*

2. *Composition of the pre-project planning team*



When project managers were asked about the quality of the pre-project plan and quality of the planning team the following results were found. The responses for both questions were very similar. The collaborative relationship mean and median value for the quality of the pre-project plan was 4.7 and 5.0, and for the team composition was a 1.3 and 1.0. For the non-collaborative

relationship the mean and median for the pre-project plan and team composition was 4.4 and 5.0 and 1.1 and 1.0, respectively.

Table 26. Project Manager Survey: Pre-Project Planning Success

Technical Elements	Mean / Median (n=40)
Site location	5.4 / 6.5
Mechanical equipment list	4.9 / 6.0
Plot Plan	4.7 / 6.0
Utility sources with supply conditions	4.7 / 5.5
Specifications	4.6 / 5.0
Equipment status	3.9 / 4.0
Environmental assessment	3.8 / 4.0
Process and information diagrams	3.7 / 4.0
Process flow sheets	3.5 / 4.0
Heat and material balances	2.4 / 2.0
Business Elements	Mean / Median (n=40)
Technology	5.1 / 6.0
Project strategy	5.1 / 5.0
Project design criteria	5.0 / 6.0
Project objectives statement	4.9 / 6.0
Site characteristics (available vs. required)	4.9 / 5.0
Capacities	4.7 / 6.0
Processes	4.6 / 5.0
Products	4.2 / 5.0
Reliability philosophy	4.1 / 5.0
Risk analysis for alternatives	3.4 / 4.0
Market strategy	3.1 / 5.0

Additionally, when project managers were asked to address the level of definition applied to both the technical and business elements of pre-project planning they responded with the results listed in Table 26. The results for each

element are listed in rank order according to mean and median with the most important features of the survey question in bolded text. When the ANOVA was performed (p-value of 0.0000) a difference between at least one of the sample means was found to be significantly different from another. However, when analyzing the confidence interval for the sample mean none of the means were found to be significantly different from the others.

It is important to note is that contractor companies feel that when they participate in the pre-project planning process the team is either not properly organized or aligned and that the plan is rather average (some definition) for being developed before execution of procurement or construction. This is further emphasized by only one activity, site plan, receiving a high score (excellent definition) and the relatively low scores of the following technical and business elements: process and information diagrams, process flow sheets, heat and material balances; and risk analysis and market strategy, respectively.

5.8.7 Project Manager Personal Experience

For a look at the personal experience of each of the project managers a list of questions were generated and each respondent was asked to provide feedback utilizing the scale given below.

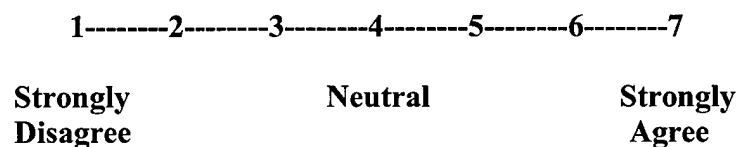


Table 27 presents the responses in rank order by mean and median from the most agreed upon comments to the least agreed upon comments. The ANOVA for each sample population resulted in a p-value of 0.0000 which demonstrates a significant difference between at least one of the mean subsamples. However, when performing the Tukey method on each question, the confidence interval for the overall, collaborative, and non-collaborative relationships did not result in a significant difference.

Overall, the relationships indicated by the project managers of the survey for both the collaborative and non-collaborative relationships were relatively good. The data below suggests that the project managers are in the position to positively affect the outcome of their respective projects.

Table 27. Project Managers Personal Experience Working with the Owner

Personal Experience	Mean / Median (n=37)
My authority matched the responsibilities assigned to me.	6.2 / 6.0
My responsibilities were clearly defined.	6.1 / 7.0
Conflicts about this project were handled appropriately through proper communication channels.	6.1 / 6.0
I felt that the project team accomplished its goals in a timely manner.	5.9 / 6.0
I look forward to working with this owner in the future.	5.8 / 7.0
I look forward to working with the people from this owner in the future.	5.8 / 7.0
I didn't know what was expected of me as a member of this team.	5.7 / 6.0
I felt that the project team used its resources effectively.	5.7 / 6.0
I felt that the combined owner and contractor companies involved in this project worked well together.	5.6 / 7.0
The communication between owner and contractor made me feel a vital part of the project.	5.6 / 6.0
I would have been comfortable giving the contractor team members a task or problem which was critical to the project, even if I could not monitor them.	5.5 / 6.0
I felt that my firm's project team worked well together.	5.5 / 6.0
I felt that the project team rapidly and effectively solved problems.	5.5 / 6.0
I worked with two or more groups on the team who operated quite differently.	5.4 / 6.0
Explanations were clear of what had to be done as a member of this team.	5.4 / 6.0
Communication practices between owner and contractor were adaptable to emergencies.	5.3 / 6.0
Informal communication between owner and contractor was active and accurate.	5.2 / 6.0
The communication between owner and contractor stimulated an enthusiasm for meeting the project's goals.	5.2 / 5.0
The owner and contractor team members had great ability as communicators.	5.0 / 5.0
I would have been comfortable giving the contractor team member's complete responsibility for the completion of this project.	5.0 / 5.0
The owner had a good way to oversee the detailed work of the contractor team members on the project.	4.7 / 5.0
I received the information needed to do my job from the owner in a timely manner.	4.5 / 5.0
I received incompatible requests about this project from two or more people.	4.4 / 4.0
I received an assignment without adequate resources and materials to execute it.	3.9 / 4.0
The owner wouldn't let the contractor team members have any influence over issues that were important to the project.	2.7 / 2.0
I worked under unclear policies and guidelines.	2.5 / 2.0
I often found myself involved in situations in which there were conflicting requirements.	1.8 / 1.0

5.8.8 New Methods and Debriefing

Continuing with the same theme from the previous question, the survey asked the project manager respondents if their working relationship with the specific owner, mentioned in the survey, had used or developed new discoveries or changed operating / interaction / and communication methods and or procedures. The questions required a “yes” or “no” answer and if a yes was given, the respondent was asked to provide a description. The responses to the questions below are provided in a yes/no format, and give a breakdown of the number of responses between collaborative and non-collaborative relationships, and include some general comments for clarification of changed areas.

1. *Did the project team discover new methods of communicating with each other?*

Collaborative

Non-Collaborative

14/7

10/6

- Collaborative: Partnering and conflict resolution was incorporated into the management process. More use of electronic forms of communication in project management.
- Non-Collaborative: Partnering was used for one company. Most utilized means of electronic communication. One firm mentioned a successful venture of owner-contractor co-location.

2. *Did the project team develop new methods for managing meetings?*

Collaborative

Non-Collaborative

10/4

8/8

- Collaborative: Incorporated action item lists with assigned responsibility and due dates. Noticed increased use of video teleconferencing.
- Non-Collaborative: Two contractors used submittal parties which are meeting for submittals of equipment, materials, and administrative requirements of the contract.

3. *Did the project team develop new methods for scheduling activities during projects?*

Collaborative

Non-Collaborative

9/12

9/7

- Both: Generally, for all companies Primavera™ was the scheduling software of choice.
- Collaborative: One company used online scheduling software.

4. *Did the project team discover new ways of coordinating among team members?*

Collaborative

Non-Collaborative

9/12

8/8

- Collaborative: Numerous meetings typically in the form of weekly meetings were held with subcontractors, vendors, owners, and engineers. Specific meetings for change orders were held.
- Non-Collaborative: Bi-weekly meetings were held. One successful venture had the company place the owner and project manager both on-site.

5. *Did the project team have a debriefing session of the entire project team, in which the team assessed any lessons learned during the project?*

Collaborative

Non-Collaborative

13/6

12/4

- Collaborative: Many companies had two meetings-one after design and one at project completion. Some additional

companies held both informal and formal meetings with all members of the team and senior management present. Some included the owner during these meetings. Some companies utilized metrics to track performance.

- Non-Collaborative: Typically a meeting “lessons learned session” was held, some with the owner, some with project team, others only had the project manager generate the “after-action” report,

6. *Was any information gained from this debriefing recorded in some form for future retrieval?*

Collaborative

Non-Collaborative

13/2

9/2

- Collaborative: Several companies had intranets and / or databases established to manage information. Some utilized metrics and others utilized some form of written critique.
- Non-Collaborative: Utilized personal logs, final job reports, and internal emails.

7. *Has any information gained from this debriefing been integrated into future projects?*

Collaborative

Non-Collaborative

11/4

9/3

- Collaborative: Importance and adherence to corporate policies was important (i.e. change management process). Companies provided distribution to similar company projects. Improved processes were: better project planning; simplified drawings, specifications, and requirements.
- Non-Collaborative: Increase the involvement of top level management; and utilize cost and schedule project controls.

5.9 SUMMARY

As stated in Chapter One of this document, it is the purpose of this thesis to analyze and document emerging trends and the changing nature of the contractor-owner relationship for capital facility projects from the contractor perspective. This chapter specifically focused on how the outcome of a capital facility project is affected by either management or project manager principles or the practices incorporated by either collaborative or non-collaborative relationships. This research was to provide contractor-owner organizations with

current trends from the contractor's perspective and provide possible recommendations to help enhance future project performance.

Overall, from the analysis it could be stated that when comparing the results of both the Management and Project Manager survey's, the results of collaborative relationships generally fared better than the non-collaborative relationships. Additionally, it is the opinion of the author that projects that encompass some form of a collaborative relationship have a better chance for success than those that have a non-collaborative relationship.

Finally, as a result of the analysis for the two surveys encompassing over 30 projects, specific issues that might be addressed to evaluate current operating practices are as follows:

- Project Managers involved in collaborative relationships with their current employers had more years of industry experience, time spent with current employer, and time spent in current title.
- Approximately, 95 percent of the project managers had degrees of higher learning.
- For this sample cost (size) was found not to be a determining factor for both collaborative and non-collaborative relationships in the contractor's ability to meet owner expectations.

- Collaborative relationships utilized more cost plus or multiple-combination "other" types of contracts. Non-collaborative relationships predominately utilized lump sum contracts.
- Analysis of project execution processes were found not be an issue for this sample.
- Separate contracts were predominately utilized for projects with a non-collaborative relationship. Both single and multiple contractor execution contracts were utilized for collaborative relationships.
- The sample results demonstrated that over time, when working with the same contractor a shift from a non-collaborative relationship to a collaborative relationship was likely to be established. Both management and project managers in collaborative relationships had a significant shift from one end of the relationship continuum (non-collaborative relationship to collaborative relationship) when addressing past and current relationships. Therefore, it is recommended that relationships be developed and maintained for a better chance of project success and more importantly within the industry.
- When asked about "they overall success" of a project, both management and project manger survey's demonstrated an

outright difference between the collaborative and non-collaborative nature of their relationships. The difference in percentage of responses between what was termed “not at all successful,” and “moderately successful” against “very successful” was significant. More responses for the “very successful” (percentage noted) were noted between the collaborative relationship and non-collaborative relationship.

- Both management and project manager respondents agreed that for their collaborative relationships when the owner participates in the capital facility process, defines goals, shares a common vision with the contractor, meets regularly, and provides feedback into the relationship, a higher chance of being successful results.
- Both management and project manager respondents stated that money and time were not being invested by the owner to develop and maintain such collaborative relationships. It could be pointed out that owners and contractors cultures are still “misaligned.” Funding for fostering new and improved relationships might be a place to invest time and money, including improved learning and continuous improvement.
- When addressing the general attributes of a successful project, the management respondents identified the contractor’s ability to

“meet the owner’s project objectives” as the most important, and to “learn from the relationship” as the least important.

- For project manager respondents the most important factor was the “contractor’s ability to meet owner’s project objectives” and the least important factor, once again, was the ability to “learn from the relationship.”
- “Learning from the relationship” is not important to either sets of the respondents and this is in sharp contrast to the goals of many owners in outsourcing services rather than performing those services in-house.
- All respondents were fairly consistent in their view in importance of required skills and traits necessary of project owners and contractor personnel. It was found that trustworthiness and communication skills were the most important skills necessary to manage a project and develop collaborative relationships, with skills needed to influence being the least important.
- The results of the survey verified that these answers provided by the contractor respondents are consistent with the owner’s desire to procure technical services by outsourcing and the contractor’s desire to keep owner personnel away from technical issues.

- Management specific results:
 - “Early involvement in pre-project planning” and “Timely decisions” provides significant benefit to the contractor, and therefore, might benefit all parties involved in the project.
 - Management respondents indicated that the most important practice in fostering collaborative relationships was utilizing a relationship coordinator with less emphasis placed on joint strategic meetings and contract development and all most no emphasis on co-location and shared information technology.
- Project manager specific results:
 - The mean cost for the collaborative relationship projects in this sample was 50 percent less than the non-collaborative relationship projects, but the collaborative relationships had a 100 percent higher cost for change orders. However, the analysis in this research suggests that collaborative relationships were considered more successful. Therefore, it might be possible that other factors are considered more important than cost or that the costs associated with the change orders were necessary. Data on specific

information pertaining to change orders was not gathered as a part of this study.

- Project cost and project deadline related issues were the two most important owner-contractor project related issues, regardless of collaborative and non-collaborative relationships.
- Less important project related issues were “responding to changes in scope and schedule,” “building an ongoing relationship,” and “building a quality project.” This should be of concern to management when “building an ongoing relationship is mentioned as a “less” important issue.
- Project processes for collaborative relationships with a high level of importance were given to “long lead/equipment listings” and “documented change management processes” with less emphasis being place on “formal vendor selection processes,” a “documented quality control program,” and “resource loaded schedules.”
- For the non-collaborative relationships the project processes “long lead/equipment listings” and “documented change management process” were more important than

the processes of “vendor bid analysis,” “documented quality control program” and “resource loaded schedules.”

- Contractor companies felt that when they participated in the pre-project planning process, in this sample the team was either not properly organized and aligned, and that the pre-project plan was rather average.
- Low scores for the following pre-project planning issues of the following technical and business elements were identified for this sample: process and information diagrams, process flow sheets, heat and material balances; risk analysis and market strategy, respectively
- Overall, the working relationships indicated by the project manager respondents of the survey for both the collaborative and non-collaborative relationships were relatively good. The data suggests that the project managers are in the position to positively affect the outcome of their respective projects.

Finally, additional comments from both management and the project managers can be found in Appendix E of this thesis. The comments provide additional insight in to the trends that have occurred over the past five years and the contractor’s insight into the most significant trends in the next three years.

Chapter 6: Conclusions and Recommendations

This chapter presents conclusions based on the results of 60 surveys and 16 different companies representing 40 projects. The statistical analysis provided extensive insight into current emerging trends within the construction industry from the contractor's perspective, using this exploratory sample.

The scope of this research was focused on identifying the organizational changes in the owner-contractor linkage caused by the increased use of business relationship networks to manage this "partnership," and the impact of these network business relationships on the contractor organizations in terms of structure, function, performance, and human resources.

Objectives of the research were: identifying the nature of the changes in the relationship, understanding what practices contribute to the effectiveness of the relationship, and whether the nature of the relationship affects the tangible outcomes of a project and its human resource requirements.

Four hypotheses were created to encompass, characterize, and capture potential areas of future conflict with owners and within contractor organizations. Those four hypotheses for this research are as follows:

The first hypothesis: *"The outsourcing of design, engineering and construction management services by owner organizations has caused the relationship structure between owners and contractors to change significantly."*

The inability of the work processes and resources needed to manage these changes to keep pace with the changes in the relationship structure has created a secondary inter-organizational boundary that defines the owner-contractor work relationship continuum."

For this sample, it was found that a significant shift in both collaborative and non-collaborative relationships has taken place from the "winning bid-first use" type of relationship to a more positive relationship of "alliance-preferred provider." So, for contractors to succeed it will be even more important for them to adjust, develop, understand, and maintain such collaborative relationships.

Owners are continuing to outsource technical aspects of capital facility projects and contractors are adapting to meet the requirement. Additionally, the relationship structure for both collaborative and non-collaborative owner-contractor relationships has changed and should continue to change over time.

The second hypothesis: *"Contractors and owners have different perceptions of the nature of collaborative relationships. Since neither party understands the intricacies of why a collaborative relationship is successful, they are unable to manage their collaborative relationships. They default to managing the relationship outcomes."*

As for project execution, processes, and resources it was found that project managers sometimes are aligned with management views and at other times have different views from management on what is important to the success of

collaborative relationships, success of a project, and success of the contractor organization. The underlying differences between management and project managers for this sample were: understanding why it is important to be involved in the earlier stages of the construction process and how to establish mechanisms for current and future collaborative relationships. Until such issues are properly addressed the imaginary boundaries that exist between the various levels of management and the owner-contractor organizations will continue to expand and possibly at the expense of project success. To manage such issues the industry must get “smarter” and “leaner” in its ability to adapt to the current and future economic climate and the possible global changes.

The third hypothesis for the management and project manager surveys was: *“The contractor community is still employing the “traditional” organization knowledge creation process but operating in an “imaginary organization” environment.”*

It was found that the collaborative relationships in general as a part of this survey sample are typically more successful than the non-collaborative relationships. However, the results of why such relationships are more successful are still rather elusive to the owner-contractor industry. The various processes, skills, traits, and attributes that were consistently found to be important to the success of such collaborative relationships were also found to not be practiced consistently. The contractor industry seems to understand the importance of such

relationships but some firms still lack the “link” to bridge the gap for improving such relationships. It was found that the practices for project operations and personnel management being conducted by the contractor firms were found to be at times in conflict with the owner organizations, within corporate practices of the human resources department, and more importantly between the various levels of management. Contractors continually stated that developing and maintaining collaborative relationships was important to their success. However, little time, effort, and money had been placed on the importance of aligning the objectives and goals for various levels of management with current hiring techniques, corporate training practices, performance appraisals, and compensation practices.

Finally, the last hypothesis addresses the human resource issues of the research and posed that *“Contractor organizations have not provided their personnel with the human resource requirements or organizational structure required to transition to the network management of business relationships.”*

For this sample, respondents have not properly addressed the continued prospect that the industry is aging and the loss of knowledge and expertise will retire in the coming decade and that new recruits needed to fill the gap of retirement age individuals will be inadequate to meet industry requirements for professionalism and expertise. This finding corresponds to the other studies.

In conclusion, it was determined upon analysis of the sample data that all four hypotheses of this sample were proven to be true. Throughout the analysis of

the sample data the underlying themes of the how owner-contractor organizations are operating from the contractor's perspective were found. The data highlighted trends between owner-contractor organizations, factors important to collaborative relationships, and how those relationships vary among the human resources, management, and project manager elements within contractor companies.

Therefore, it is recommended that additional research be pursued in the following areas as discussed below. When conducting future research the sample size should be increased and the survey questions should be reduced to only those elements that were found to be significantly different (or demonstrated an obvious difference in this exploratory study).

It should be considered important to address the shortfalls of the human resources chapter in terms of hiring practices, new and annual training, performance appraisal process, and how the aging workforce's knowledge is going to be passed-on and individuals are going to be replaced.

As for Chapter Five, additional research projects could investigate how to shift more effectively from non-collaborative to collaborative relationships and why these might ultimately become successful. Based on the sample data it could be said that collaborative relationships are more successful than non-collaborative relationships in terms of project success.

It is of the opinion of the author that management, rather than project managers, should work more closely to align themselves and their respective

organizations to the needs of the owners. This should be used as a starting point for future work and additionally those researchers should work to understand how best to align other levels of management within contractor organizations between one another and in concert with owner organizations.

Appendix A: Participation Table

Participation Table

Organization	HR Survey	Management Survey		Project Manager Survey
		Number Respondents	Number Projects	(Number of respondents equal to Number of projects)
Austin Brothers				1
Beck Group				4
BE&K Eng., Birmingham	1	1	4	2
BE&K Inc., Louisville	1	1	2	1
Burns & Roe	1	1	4	3
CUH2A	1			1
Day Zimmerman	1			
Faulkner	1	1	4	1
J.G. Kennedy				1
KB&R				3
Kvaerner	1	1	2	4
Morrison-Knudson		1	2	3
Rust Engineering	1			3
Syska & Hennessey	1	1	4	2
TDI	1	1	4	7
Turner Corp	1	1	2	4
Totals:	11	9	28	40

Appendix B: Human Resources Survey

CENTER FOR CONSTRUCTION INDUSTRY STUDIES
The University of Texas at Austin
Owner/Contractor Organizational Changes Study Team
Contractor Capital Facility Project Survey

I am one of a group of researchers from the University of Texas at Austin studying collaborative relationships between design, engineering and construction management contractors and owners for the construction of capital facilities. As part of our research, we are collecting data on the human resources requirements and practices in approximately 20 contractor organizations. You have been invited to participate because you provide the human resources support and coordination for the staffing, training and career development of the technical staff for capital facility projects in your organization. However, you are under no obligation to participate in this research nor must you answer every question.

If you decide to participate, please complete this questionnaire. To get the most accurate results, it is essential that individuals provide detailed data and be candid in their responses. There are no right or wrong answers to the survey questions. The survey will take approximately 30 minutes to complete. Please return your survey directly to the University of Texas. A pre-addressed envelope has been provided for this purpose.

Your responses to this survey will be completely confidential. All information gathered as part of this project will be treated in strictest confidence and kept under conditions of security at the University of Texas at Austin. We will provide your employer only with a summary of general trends and statistical relationships across all the projects and organizations included in this study. Specific individuals and jobs will not be named in this summary. The results of this project will be used to enhance project performance and human resource practices in order to improve the competitiveness of the U.S. construction industry.

Thank you for your participation. If you have any questions about this survey, or desire a copy of the survey results, please contact me directly at (512) 471-0872 or via e-mail at d.ryan-rose@mail.utexas.edu or you may contact the study supervisor, Dr. G. Edward Gibson, Jr. at (512) 471-4522 or via e-mail at egibson@mail.utexas.edu.

Donna J. Ryan-Rose
Graduate Research Assistant
Civil Engineering Department
University of Texas at Austin

The survey begins on the next page.

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Owner/Contractor Organizational Changes Study Team

Note: These questions refer ONLY to personnel in the project architectural design, project engineering design or project construction management functions.

Selection

The following questions refer to your company's current hiring practices for the project architectural design, project engineering design or project construction management functions. Please circle which project function this survey addresses:

Project Architectural Design Project Engineering Design Project Construction Management

1. When you hire externally for this project function on average how many qualified applicants do you have per position?

_____ applicants per position

2. What weight do you give the following factors when hiring for this project function?

	Very Little Weight			Moderate Weight		Very Heavy Weight	
	1	2	3	4	5	6	7
a. previous experience in this project function with an owner firm	1	2	3	4	5	6	7
b. previous experience in this project function with a contractor firm	1	2	3	4	5	6	7
c. willingness to learn new skills	1	2	3	4	5	6	7
d. ability to work with others	1	2	3	4	5	6	7
e. quality of institution(s) where degree(s) were received	1	2	3	4	5	6	7
f. completion of a master's degree	1	2	3	4	5	6	7
g. general experience in your industry	1	2	3	4	5	6	7

3. How frequently do you use the following tools when hiring for this project function?

	Very Little Use			Neutral		Very Heavy Use	
a. Unstructured interviews	1	2	3	4	5	6	7
b. Structured interviews	1	2	3	4	5	6	7
c. skills and abilities tests	1	2	3	4	5	6	7
d. personality tests	1	2	3	4	5	6	7
e. formal records of past achievement (e.g., transcripts, certifications)	1	2	3	4	5	6	7
f. other (specify) _____	1	2	3	4	5	6	7

4. When hiring for this project function, indicate whether or not you formally screen prospective applicants for the following personality traits.

Trait	Definition	Do you screen for this trait?	Method used for screening for this trait
a. Agreeableness	Ability to get along with others and be open minded to new ideas.	yes/no	
b. Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.	yes/no	
c. Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.	yes/no	
d. Conscientiousness	Perseverance, responsibility, and thoroughness in completing tasks.	yes/no	
e. Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.	yes/no	
f. Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.	yes/no	
g. Other (specify) _____		yes/no	

Performance Appraisals

The following questions refer to your company's current performance appraisal practices for this project function.

1. What percentage of the personnel in this project function receives written annual performance appraisals?
_____ %
2. For what percentage of the personnel in this project function are performance appraisals used to determine compensation?
_____ %
3. In your company, what criteria are used to evaluate personnel in this project function? If available, attach a blank performance appraisal. If not, enter criteria used for evaluation and the weight of each criterion in the final appraisal score.

Criterion	Weight	Criterion	Weight
a.	_____ %	d.	_____ %
b.	_____ %	e.	_____ %
c.	_____ %	f.	_____ %

Training

The following questions refer to your company's current training practices for this project function.

1. Indicate how much training personnel in this project function receive for the following skills during their first year on the job and annually thereafter (in days). If training is ongoing over a person's career, please estimate the number of days of training in a given year.

Skill	Examples	Days of training for new personnel (first year)	Annual days of training for personnel (after first year)
a. Business skills	Writing and managing contracts, negotiation, and managing budgets and schedules	_____ days	_____ days
b. Communication skills	Coordination/liaison, conflict management, and cultivation of a broad network of relationships	_____ days	_____ days
c. Influence skills	Mentoring, motivating, and change management	_____ days	_____ days

d. Managerial skills	Team building, delegating, political awareness, and the ability to see the big picture	_____ days	_____ days
e. Problem solving skills	Continually analyzing options, planning, and considering both sides of issues	_____ days	_____ days
f. Technical skills	Understanding of the entire construction process, engineering knowledge, and knowledge of information technology	_____ days	_____ days
g. Other (specify)	_____	_____ days	_____ days

Compensation

The following questions refer to your company's current compensation practices for this project function.

- Which of the following forms of compensation are used for this project function? (circle all that apply)
 - COLA
 - Merit increase
 - Bonuses
 - Stock options/grants
 - Incentive pay
- What percentage of the pay for personnel in this project function is typically contingent on the factors listed below? Make sure each column totals 100%.

Factor	Project Manager	Project Engineer
a. Individual performance	_____ %	_____ %
b. Project performance	_____ %	_____ %
c. Office or SBU performance	_____ %	_____ %
d. Corporate performance	_____ %	_____ %
Total for this column	_____ %	_____ %

Career Paths

The following questions refer to your company's current career paths for this project function.

1. Describe the typical sequence of jobs through which personnel in this project function progress. If there is no career path, indicate NONE on the first row below. List jobs from lowest to highest hierarchical level.

Job Title	Typical amount of time at this job title	% of jobs at this level filled from within in recent years
a.	_____ years	_____ % internal hires
b.	_____ years	_____ % internal hires
c.	_____ years	_____ % internal hires
d.	_____ years	_____ % internal hires
e.	_____ years	_____ % internal hires

2. Of the job titles listed above, what is the highest job title typically attained by personnel in this project function originally hired at the entry level?

Organizational Diversity

The following question refers to your company's diversity

1. Describe the distribution of this project job function by age. Please describe the distribution of each age factor by gender.

Factor	Distribution	Factor Distribution by Gender	
a. under 29	%	% Male	% Female
b. 30 – 39	%	% Male	% Female
c. 40 – 49	%	% Male	% Female
d. 50 – 59	%	% Male	% Female
e. 60 – 69	%	% Male	% Female
f. over 70	%	% Male	% Female

Thank you for your participation.

Appendix C: Management Survey

CENTER FOR CONSTRUCTION INDUSTRY STUDIES
The University of Texas at Austin
Owner/Contractor Organizational Changes Study Team
Contractor Capital Facility Project Survey

I am one of a group of researchers from the University of Texas at Austin studying collaborative relationships between design, engineering and construction management contractors and owners for the construction of capital facilities. As part of our research, we are collecting data on several specific projects in approximately 20 contractor organizations. You have been invited to participate because your organization recently concluded a capital facility project. However, you are under no obligation to participate in this research nor must you answer every question.

If you decide to participate, please complete this questionnaire. To get the most accurate results, it is essential that individuals provide detailed data and be candid in their responses. There are no right or wrong answers to the survey questions. The survey will take approximately 30 minutes to complete. Please return your survey directly to the University of Texas.

Your responses to this survey will be completely confidential All information gathered as part of this project will be treated in strictest confidence and kept under conditions of security at the University of Texas at Austin. We will provide your employer with only a summary of general trends and statistical relationships across all the projects and organizations participating in this study. Specific individuals, jobs, and projects will not be named in this summary. The results of this project will be used to enhance project performance and to improve competitiveness of the U.S. construction industry.

Thank you for your participation. If you have any questions about this survey, or desire a copy of the survey results, please contact me directly at (512) 471-0872 or via e-mail at dryan-rose@mail.utexas.edu or you may contact the study supervisor, Dr. G. Edward Gibson, Jr. at (512) 471-4522 or via e-mail at ggibson@mail.utexas.edu.

Donna J. Ryan-Rose
Graduate Research Assistant
Civil Engineering Department
University of Texas at Austin

The survey begins on the next page.

CENTER FOR CONSTRUCTION INDUSTRY STUDIES
University of Texas at Austin
Owner/Contractor Organizational Changes Study Team

Please identify four different capital facility projects from your company for inclusion in this research. These four projects should be distinct from one another so that they were budgeted and scheduled separately. The criteria for each project will be listed below:

Project One Information

The first project should meet the following criteria:

- Project performance was **above average**.
- Completed within the last four years ('95-1999).
- Domestic location (located within the North America)
- Over \$2 million total project cost
- Primary project manager still employed by your company.
- Project was executed for an owner organization with which you have a formal or informal collaborative relationship

1. Project Name: _____
2. Who was the primary project manager on this project? _____
3. Circle the letter by the phrase that best describes the relationship between your employer and this project's owner organization.
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - e. First use. No previous relationship.
4. Has the nature of your relationship with this owner changed over time?
 - a. Yes
 - b. No
5. If so, what type of relationship best described your relationship in the past?
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - e. First use. No previous relationship.
 - f. Same as current relationship from question 14 above.

6. What are the benefits to your employer of this owner organization relationship? (Circle all that apply. Then rank the selected answers in order of importance, with #1 being the most important)
- | | Ranking |
|---|---------|
| a. Reduction in business development costs | _____ |
| b. Early involvement in project planning | _____ |
| c. Consistent flow of work | _____ |
| d. Improved ability to match owner's needs with level of service provided | _____ |
| e. Timely identification and resolution of problems | _____ |
| f. Improved communication | _____ |
| g. Timely decisions | _____ |
| h. Improved project performance | _____ |
| i. Improved exchange of business and project information | _____ |
| Other _____ | _____ |

7. Indicate the success of the working relationship with this owner firm on this project.
- | Not at all successful | | Moderately successful | | Very successful | |
|-----------------------|---|-----------------------|---|-----------------|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | | | |

Please explain your answer to question 7 above

8. Based on the results of this project, I would like to make investments in the following practices (either create or improve existing practices) to create a closer working relationship with this owner organization. (Circle all that apply.)
- shared information systems
 - co-location
 - joint strategic planning meetings
 - relationship coordinators
 - formal contract

How well do the statements below describe your experience with this owner?

	Strongly Disagree			Neutral		Strongly Agree	
	1	2	3	4	5	6	7
9. We are the primary source of design, engineering and/or construction management services for this owner							
10. This owner is requesting that we supply a more diversified assortment of services.							
12. Our organizational cultures are strongly aligned.							
13. We entered our relationship with a strong-shared vision							

14. We meet regularly to address emerging issues	1	2	3	4	5	6	7
15. We defined specific goals for our relationship.	1	2	3	4	5	6	7
16. The owner actively participates in the capital facility project process.	1	2	3	4	5	6	7
17. We evaluate our relationship performance against our goals on a regular basis	1	2	3	4	5	6	7
18. We focus on learning and continuous improvement.	1	2	3	4	5	6	7
19. The owner understands the capital facility project design and construction process.	1	2	3	4	5	6	7
20. The owner provides positive feedback on our performance on a regular basis	1	2	3	4	5	6	7
21. There is a budget set up to cover the internal costs of maintaining and developing this owner relationship.	1	2	3	4	5	6	7

Please explain your answer to any question that you rated 1 or 2.

Project Two Information

The second project should meet the following criteria:

- Project performance was **below average**.
- Completed within the last four years (1995-1999).
- Domestic location (located within the North America).
- Over \$2 million total project cost
- Primary project manager still employed by your company.
- Project was executed for an owner organization with which you have a formal or informal collaborative relationship

1. Project Name: _____
2. Who was the primary project manager on this project? _____
3. Circle the letter by the phrase that best describes the relationship between your employer and this project's owner organization.
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - e. First use. No previous relationship.
4. Has the nature of your relationship with this owner changed over time?
 - a. Yes
 - b. No
5. If so, what type of relationship best described your relationship in the past?
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - e. First use. No previous relationship.
 - f. Same as current relationship from question 14 above.
6. What are the benefits to your employer of this owner organization relationship? (Circle all that apply. Then rank the selected answers in order of importance, with #1 being the most important)

	Ranking
a. Reduction in business development costs	_____
b. Early involvement in project planning	_____
c. Consistent flow of work	_____
d. Improved ability to match owner's needs with level of service provided	_____
e. Timely identification and resolution of problems	_____
f. Improved communication	_____
g. Timely decisions	_____
h. Improved project performance	_____
i. Improved exchange of business and project information	_____

Other _____

7. Indicate the success of the working relationship with this owner firm on this project	Not at all successful		Moderately successful			Very successful	
	1	2	3	4	5	6	7

Please explain your answer to question 7 above:

8. Based on the results of this project, I would like to make investments in the following practices (either create or improve existing practices) to create a closer working relationship with this owner organization. (Circle all that apply.)
- a. shared information systems
 - b. co-location
 - c. joint strategic planning meetings
 - d. relationship coordinators
 - e. formal contract

How well do the statements below describe your experience with this owner?

	Satisfaction with this owner?						
	Strongly Disagree		Neutral			Strongly Agree	
	1	2	3	4	5	6	7
9. We are the primary source of design, engineering and/or construction management services for this owner.							
10. This owner is requesting that we supply a more diversified assortment of services							
12. Our organizational cultures are strongly aligned.							
13. We entered our relationship with a strong-shared vision.							
14. We meet regularly to address emerging issues.							
15. We defined specific goals for our relationship							
16. The owner actively participates in the capital facility project process							
17. We evaluate our relationship performance against our goals on a regular basis.							
18. We focus on learning and continuous improvement.							

19. The owner understands the capital facility project design and construction process.	1	2	3	4	5	6	7
20. The owner provides positive feedback on our performance on a regular basis.	1	2	3	4	5	6	7
21. There is a budget set up to cover the internal costs of maintaining and developing this owner relationship.	1	2	3	4	5	6	7

Please explain your answer to any question that you rated 1 or 2.

The following questions address owner-contractor relationships in general.

1. Please rank the following list of relationship indicators based on their importance to the success of an owner-contractor relationship. (Please use a scale of 1 to 7, where 1 is the most important and 7 is the least important.)

Attribute	Definition	Rating
Contractor meets owner's Project objectives	The project is delivered on or ahead of schedule and budget targets with minimal rework in the field. Startup is smooth.	
Contractor understands owner's business	Contractor personnel understand owner's business objectives and operating systems and procedures	
Integration of owner and contractor personnel	Owner and contractor work together repeatedly, using many of the same personnel from project to project. Owner and contractor develop effective communication structures, a shared vocabulary, and a common project culture. Owner and contractor systems are integrated to the extent possible. Trust develops between owner and contractor personnel. Multiple levels of personnel are involved in both the owner and contractor organization.	
Contractor responsiveness to changing conditions	Contractor responds quickly and effectively to owner needs. Contractor informs owner as early as possible about upcoming difficulties.	
Contractor willingness to innovate	Contractor is willing to challenge owner ideas, recommend improvements, and take risks.	
Operating for mutual benefit	The relationship benefits both owner and contractor. Gains made through a productive relationship, such as cost savings, are shared between owner and contractor.	
Learning from the relationship is documented and used	Owner and contractor explicitly discuss and document the lessons learned from each project. If possible, these lessons are integrated into systems and procedures that can be reused on subsequent projects.	

2. What do you think are the most significant changes in the construction industry in the past 5 years?

3. What do you think will be the most significant changes in the construction industry in the next 3 years?

4. Please rank the following list of skills and traits based on their importance to the ability of:

a). Contractor personnel in a key project position to successfully fulfill their duties and responsibilities?

b). Owner personnel in a key project position to successfully fulfill their duties and responsibilities?

(Please use a scale of 1 to 12 in ranking these items, where *1 is the most important* and *12 is the least important*. Each number should be used only once)

Trait	Definition	Contractor	Owner
Agreeableness	Ability to get along with others and be open minded to new ideas.		
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.		
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities		
Conscientiousness	Perseverance, responsibility, and thoroughness in completing task.		
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.		
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self		
Business Skills	Writing and managing contracts, Negotiation, Managing budgets and schedules		
Communication Skills	Coordination/liaison, Conflict management Cultivate broad network of relationships		
Influence Skills	Mentoring, Motivating, Change management		
Managerial Skills	Team building, Delegating, Politically aware/see big picture		
Problem Solving Skills	Continually analyze options/innovation, Planning, Consider both sides of issues, risk management		
Technical Skills	Understand entire construction process, Multi-disciplined (knowledge of several areas of engineering), Information technology skills		

Project Three Information

The third project should meet the following criteria

- Project performance was **above average**.
- Completed within the last four years (1995-1999)
- Domestic location (located within the North America)
- Over \$2 million total project cost.
- Primary project manager still employed by your company.
- Project was executed for an owner organization with which you **do not** have a formal or informal collaborative relationship

1. Project Name: _____
2. Who is the primary project manager on this project? _____
3. Circle the letter by the phrase that best describes the relationship between your employer and this project's owner organization
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - e. First use. No previous relationship.

4. Indicate the success of the working relationship with this owner firm on this project.

Not at all successful		Moderately successful			Very successful	
1	2	3	4	5	6	7

How well do the statements below describe your experience with this owner?

	Strongly Disagree		Neutral			Strongly Agree	
	1	2	3	4	5	6	7
5. Our organizational cultures are strongly aligned	1	2	3	4	5	6	7
6. We entered this project with a strong- shared vision	1	2	3	4	5	6	7
7. We meet regularly to address emerging issues	1	2	3	4	5	6	7
8. We defined specific goals for this project	1	2	3	4	5	6	7

9. The owner actively participates in the capital facility project process.	1	2	3	4	5	6	7
10. We evaluate our project performance against our goals on a regular basis.	1	2	3	4	5	6	7
11. We focus on learning and continuous improvement.	1	2	3	4	5	6	7
12. The owner understands the capital facility project design and construction process.	1	2	3	4	5	6	7
13. The owner provides positive feedback on our project performance on a regular basis.	1	2	3	4	5	6	7

Please explain your answer to any question that you rated 1 or 2.

Project Four Information

The fourth project should meet the following criteria:

- Project performance was below average.
- Completed within the last four years (1995-1999).
- Domestic location (located within the North America).
- Over \$2 million total project cost.
- Primary project manager still employed by your company.
- Project was executed for an owner organization with which you do not have a formal or informal collaborative relationship.

1. Project Name: _____
2. Who is the primary project manager on this project? _____
3. Circle the letter by the phrase that best describes the relationship between your employer and this project's owner organization.
 - a. Formal alliance. You and the owner have an alliance with written terms and conditions.
 - b. Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - c. Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - d. Winning bid. No special relationship.
 - f. First use. No previous relationship.

4. Indicate the success of the working relationship with this owner firm on this project.	Not at all successful		Moderately successful			Very successful	
	1	2	3	4	5	6	7

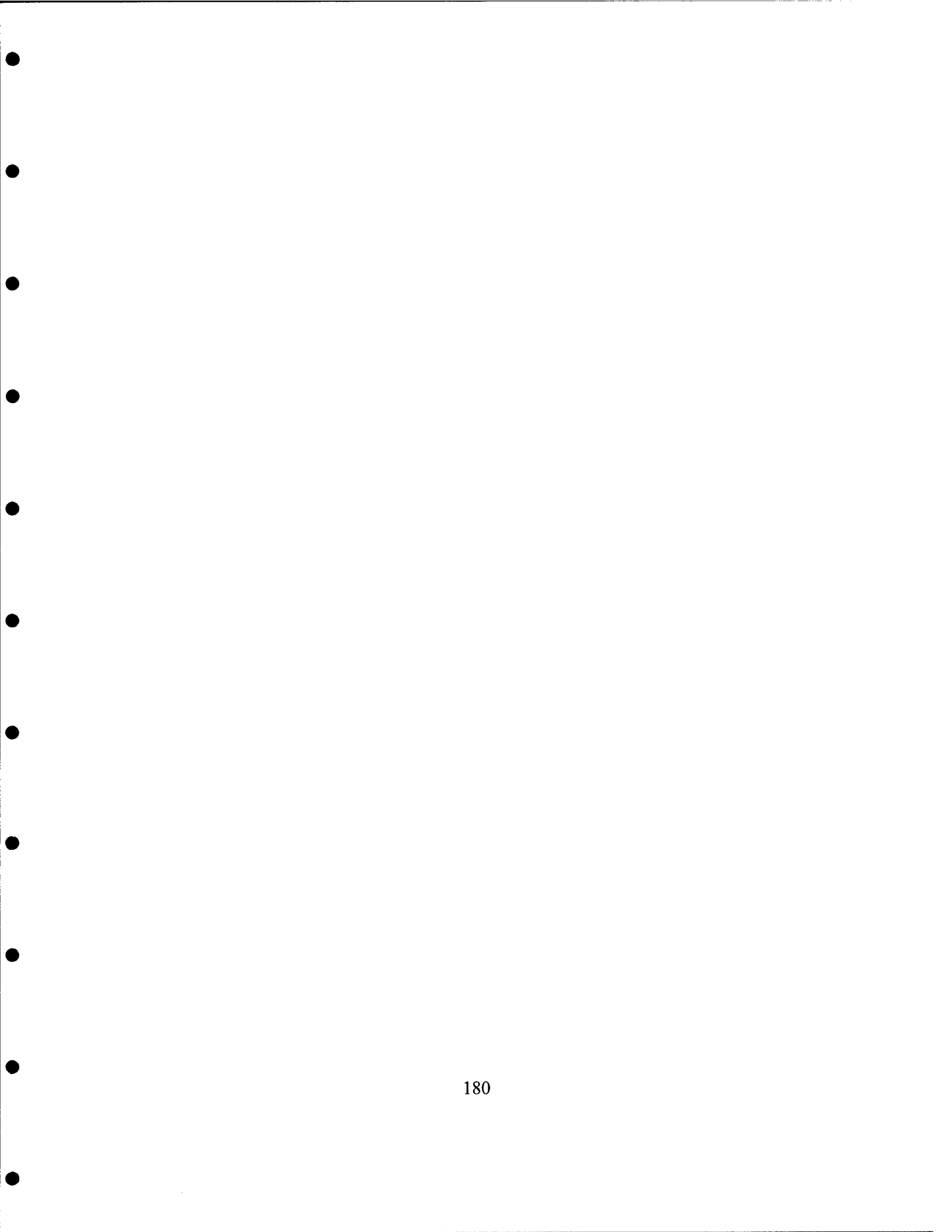
How well do the statements below describe your experience with this owner?

	How well do the statements below describe your experience with this owner?						
	Strongly Disagree			Neutral		Strongly Agree	
	1	2	3	4	5	6	7
5. Our organizational cultures are strongly aligned	1	2	3	4	5	6	7
6. We entered this project with a strong shared vision	1	2	3	4	5	6	7
7. We meet regularly to address emerging issues	1	2	3	4	5	6	7
8. We defined specific goals for this project	1	2	3	4	5	6	7
9. The owner actively participates in the capital facility project process.	1	2	3	4	5	6	7
10. We evaluate our project performance against our goals on a regular basis.	1	2	3	4	5	6	7
11. We focus on learning and continuous improvement.	1	2	3	4	5	6	7
12. The owner understands the capital facility project design and construction process.	1	2	3	4	5	6	7
13. The owner provides positive feedback on our project performance on a regular basis.	1	2	3	4	5	6	7

Please explain your answer to any question that you rated 1 or 2.

Thank you for your participation.

Appendix D: Project Manager Survey



CENTER FOR CONSTRUCTION INDUSTRY STUDIES
The University of Texas at Austin
Owner/Contractor Organizational Changes Study Team
Owner Capital Facility Project Survey

Dear Project Manager:

I am one of a group of researchers from the University of Texas at Austin studying collaborative relationships between design, engineering and construction management contractors and owners for the construction of capital facilities. As part of our research, we are collecting data on several specific projects in approximately 20 contractor organizations. You have been invited to participate because you were a project manager for a recently concluded capital facility project. However, you are under no obligation to participate in this research nor must you answer every question.

If you decide to participate, please complete this questionnaire with reference to only the particular capital facility project mentioned later in the survey. To get the most accurate results, it is essential that individuals provide detailed data on specific projects and be candid in their responses. There are no right or wrong answers to the survey questions. The survey will take approximately 45 minutes to complete. Please return your survey directly to the University of Texas.

Your responses to this survey will be completely confidential. All information gathered as part of this project will be treated in strictest confidence and kept under conditions of security at the University of Texas at Austin. We will provide your employer with only a summary of general trends and statistical relationships across all the projects and organizations participating in this study. Specific individuals, jobs, and projects will **not** be named in this summary. The results of this project will be used to enhance project performance and to improve competitiveness of the U.S. construction industry.

Thank you for your participation. If you have any questions about this survey, or desire a copy of the survey results, please contact me directly at (512) 471-0872 or via e-mail at d.ryan-rose@mail.utexas.edu or you may contact the study supervisor, Dr. G. Edward Gibson, Jr. at (512) 471-4522 or via e-mail at egibson@mail.utexas.edu.

Donna J. Ryan-Rose
Graduate Research Assistant
Civil Engineering Department
University of Texas at Austin

The survey begins on the next page.

Note: In the next several sections, the phrase "the project" refers only to the project listed below.

The term "owner" refers to the organization that will own, occupy, and be financially responsible for the operation and maintenance of the capital facility being constructed.

The term "contractor" refers to the organization that supplied design, engineering or construction management services for this project. It DOES NOT REFER TO THE CONSTRUCTION TRADE CONTRACTOR.

II. Please tell us about this project.

1. Project Name: _____
2. In what state or province was the project located? _____
3. What type of facility is this project?
 - a. Oil Exploration/Production
 - b. Oil Refining
 - c. Pulp and Paper
 - d. Chemical Manufacturing
 - e. Environmental
 - f. Pharmaceuticals Manufacturing
 - g. Metals Refining/Processing
 - h. Microelectronics Manufacturing
 - i. Consumer Products Manufacturing
 - j. Natural Gas Processing
 - k. Lowrise Office
 - l. Highrise Office
 - m. Warehouse
 - n. Laboratory
 - o. Maintenance Facilities
 - p. Parking Garage
 - q. Retail
 - r. Other (specify) _____
4. Which of the following best describes the site on which this project was built? (If more than 25% of the project was a retrofit, please classify the project as a Retrofit/Expansion)
 - a. Grassroots
 - b. Retrofit/Expansion
 - c. Co-Located
 - d. Other
5. Please indicate if any of the following aspects of this project were unique for your company? (Circle all that apply.)
 - a. New process technology for the company/location
 - b. First of a kind process technology for the industry
 - c. New project management process
 - d. Largest of its type in the company
 - e. First project with this design contractor
 - f. Other (for example: equipment, location, execution, etc.)
 - g. Nothing unique

6. Indicate how the completed facility (considering the final cost) compares against expectations.
- | Much worse than expected | | | As expected | Much better than expected | | |
|--------------------------|---|---|-------------|---------------------------|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
7. Was a single E/P/C contractor used, or were separate Design, Engineering, Procurement, and Construction contractors used?
- single E/P/C contractor
 - separate contractors
8. What type of contract was used for this project? (Select only one answer)
- Lump Sum
 - Lump Sum with Incentive
 - Cost Plus with Fee
 - Cost Plus with Incentive
 - Other _____ (please specify)
9. Circle the letter by the phrase that best describes the relationship between your employer and this project's owner organization.
- Formal alliance. You and the owner have an alliance with written terms and conditions.
 - Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - Winning bid. No special relationship. (Skip to Section III)
 - First use. No previous relationship. (Skip to Section III)
10. Approximately how long has your employer maintained a relationship with this owner?
_____ Years
11. Has the nature of your relationship with this owner changed over time?
- Yes
 - No
12. If so, what type of relationship best described your relationship in the past?
- Formal alliance. You and the owner have an alliance with written terms and conditions.
 - Informal alliance. The owner is considered an alliance partner but no written agreement exists.
 - Preferred provider. Your organization is a first choice contractor, but there is no alliance.
 - Winning bid. No special relationship.
 - First use. No previous relationship.
 - Same as current relationship from question 9 above.

IV. Please tell us about the owner's team.

1. Please list below the titles and functions of the key or lead members of the project team from the owner's organization. List no more than 10 individuals. Please answer the questions in the table for each team member you list.

Team member's titles (from the owner's organization)	What was the primary responsibility of this person?	Did you have regular contact with this person?	Was this person included in the original team?	Was this person on the team when it was disbanded?	Have you worked with this person on any prior project?
1.		yes/no	yes/no	yes/no	yes/no
2.		yes/no	yes/no	yes/no	yes/no
3.		yes/no	yes/no	yes/no	yes/no
4.		yes/no	yes/no	yes/no	yes/no
5.		yes/no	yes/no	yes/no	yes/no
6.		yes/no	yes/no	yes/no	yes/no
7.		yes/no	yes/no	yes/no	yes/no
8.		yes/no	yes/no	yes/no	yes/no
9.		yes/no	yes/no	yes/no	yes/no
10.		yes/no	yes/no	yes/no	yes/no

2. Which of the following best describes the physical location of owner and contractor personnel working on this project?
- Some owner personnel co-located in contractor's office
 - Some contractor personnel co-located in owner's office
 - Both contractor and owner personnel co-located in the other's offices
 - Neither contractor or owner personnel co-located in the other's offices
3. I would describe the amount of work that I do with this owner as _____
- greater than that with other owners.
 - less than that with other owners.
 - about the same as that with other owners.

III. Please tell us about yourself and the other owner personnel who worked on this project.

1. Since joining your current employer, how many projects have you worked on with this owner?
_____ projects

2. Have you ever been an employee of the owner organization of this project?
a. Yes
b. No. If no, skip to Question #5.

3. If so, while employed by this owner, did you ever work on projects for your current employer?
a. Yes
b. No. If no, skip to Question #5.

4. If so, how many projects did you work on? _____ projects

5. How many contractor personnel, including yourself, were assigned to work on this project?
_____ contractor personnel were assigned (including myself)

6. Including yourself, please list the positions, and functions of employees of your company (full-time, part-time, or sourced contractors) who played a key role in the project.

Job title	Key function(s) provided

V. Please tell us about the project.

1. Projects can be thought of as occurring in stages. During which stages of the project were personnel from your firm involved? (Please circle all that apply and select the level of involvement for each stage as defined below.)

Project Stage	Level of Involvement						
	None			Partial			Full
	1	2	3	4	5	6	7
a. <i>Feasibility analysis/business planning</i> The preparation of conceptual project design, scope, cost estimates, and risk scenarios.							
b. <i>Pre-project planning</i> Acquiring strategic information to address benefits and risks and commit resources that increase the chance of project success. Also, project site and technology selection and detailed project scope development.							
c. <i>Detailed design</i> The process of transferring the scope of the project into plans, material, and equipment specifications and drawings.							
d. <i>Procurement</i> Planning and control to ensure the correct materials and installed equipment are specified in a timely manner, obtained at reasonable cost, and available when needed.							
e. <i>Construction</i> Building, including support required to install facility equipment/materials.							
f. <i>Start-up</i> Period from mechanical completion of the project to operation or occupancy.							
g. <i>Operation</i> Use of the facility for its intended purpose.							

2. Did your organization formally assess the quality of the pre-project planning effort?
- Yes
 - No

3. Please evaluate the following items:	Poor		Neutral		Excellent	
	1	2	3	4	5	6
a. Quality of the pre-project plan						
b. Composition of the pre-project planning team						

4. Please indicate how well defined each element of the project was *prior to the total project budget authorization* by selecting the description that fits each element best. If an item is not applicable to this project, please check n/a.

Technical Elements	Incomplete Definition		Some Deficiencies			Complete Definition		n/a
	1	2	3	4	5	6	7	
a. Process flow sheets	1	2	3	4	5	6	7	<input type="checkbox"/>
b. Site location	1	2	3	4	5	6	7	<input type="checkbox"/>
c. Process and information diagrams	1	2	3	4	5	6	7	<input type="checkbox"/>
d. Heat and material balances	1	2	3	4	5	6	7	<input type="checkbox"/>
e. Environmental assessment	1	2	3	4	5	6	7	<input type="checkbox"/>
f. Utility sources with supply conditions	1	2	3	4	5	6	7	<input type="checkbox"/>
g. Mechanical equipment list	1	2	3	4	5	6	7	<input type="checkbox"/>
h. Specifications-process/mechanical	1	2	3	4	5	6	7	<input type="checkbox"/>
i. Plot plan	1	2	3	4	5	6	7	<input type="checkbox"/>
j. Equipment status	1	2	3	4	5	6	7	<input type="checkbox"/>
Business Elements	Incomplete Definition		Some Deficiencies			Complete Definition		n/a
	1	2	3	4	5	6	7	
k. Products	1	2	3	4	5	6	7	<input type="checkbox"/>
l. Capacities	1	2	3	4	5	6	7	<input type="checkbox"/>
m. Technology	1	2	3	4	5	6	7	<input type="checkbox"/>
n. Processes	1	2	3	4	5	6	7	<input type="checkbox"/>
o. Site characteristics (available vs. required)	1	2	3	4	5	6	7	<input type="checkbox"/>
p. Market strategy	1	2	3	4	5	6	7	<input type="checkbox"/>
q. Project objectives statement	1	2	3	4	5	6	7	<input type="checkbox"/>
r. Project strategy	1	2	3	4	5	6	7	<input type="checkbox"/>
s. Project design criteria	1	2	3	4	5	6	7	<input type="checkbox"/>
t. Reliability philosophy	1	2	3	4	5	6	7	<input type="checkbox"/>
u. Risk analysis for alternatives	1	2	3	4	5	6	7	<input type="checkbox"/>

To what extent were the following processes used on this project.

	Not at all			To some extent			To a large extent		n/a
	1	2	3	4	5	6	7		
5. A resource loaded schedule for the design phase of this project was followed.								<input type="checkbox"/>	
6. A system was in place to ensure the timely communication of change information to the proper design disciplines and project participants	1	2	3	4	5	6	7	<input type="checkbox"/>	
7. A formally documented change management process was used to actively manage the changes on this project.	1	2	3	4	5	6	7	<input type="checkbox"/>	
8. A constructability review was performed with the design team.	1	2	3	4	5	6	7	<input type="checkbox"/>	
9. A formally documented quality control program was used to actively manage design quality on this project.	1	2	3	4	5	6	7	<input type="checkbox"/>	
10. A formally documented materials management and tracking process was used to actively manage the procurement process on this project.	1	2	3	4	5	6	7	<input type="checkbox"/>	
11. Long lead/critical equipment listings were developed for this project and used in the procurement process.	1	2	3	4	5	6	7	<input type="checkbox"/>	
12. Formally documented vendor pre-qualification and selection criteria were developed and actively used in this project.	1	2	3	4	5	6	7	<input type="checkbox"/>	
13. Bid analysis and award processes were developed and actively applied to each bid package.	1	2	3	4	5	6	7	<input type="checkbox"/>	
14. Clear, comprehensive and project specific material and equipment specifications were developed and incorporated into the procurement packages.	1	2	3	4	5	6	7	<input type="checkbox"/>	

15 To what extent did you and the owner place similar levels of importance on each of the following issues:

	Not at all			To some extent		To a large extent	
	1	2	3	4	5	6	7
a. Project cost	1	2	3	4	5	6	7
b. Project deadlines	1	2	3	4	5	6	7
c. Responding to changes in project scope	1	2	3	4	5	6	7
d. Responding to changes in project schedule	1	2	3	4	5	6	7
e. Building an ongoing relationship	1	2	3	4	5	6	7
f. Quality of the completed project	1	2	3	4	5	6	7

How well do the statements below describe your personal experience on this project.

	Strongly Disagree			Neutral		Strongly Agree	
	1	2	3	4	5	6	7
16. My authority matched the responsibilities assigned to me.	1	2	3	4	5	6	7
17. The owner and contractor team members had great ability as communicators.	1	2	3	4	5	6	7
18. I worked with two or more groups on the team who operated quite differently.	1	2	3	4	5	6	7
19. The communication between owner and contractor stimulated an enthusiasm for meeting the project's goals.	1	2	3	4	5	6	7
20. My responsibilities were clearly defined.	1	2	3	4	5	6	7
21. The owner had a good way to oversee the detailed work of the contractor team members on the project.	1	2	3	4	5	6	7
22. Informal communication between owner and contractor was active and accurate.	1	2	3	4	5	6	7
23. I worked under unclear policies and guidelines.	1	2	3	4	5	6	7

	Strongly Disagree		Neutral			Strongly Agree	
	1	2	3	4	5	6	7
24. The owner wouldn't let the contractor team members have any influence over issues that were important to the project.	1	2	3	4	5	6	7
25. The communication between owner and contractor made me feel a vital part of the project.	1	2	3	4	5	6	7
26. I would have been comfortable giving the contractor team members complete responsibility for the completion of this project.	1	2	3	4	5	6	7
27. I would have been comfortable giving the contractor team members a task or problem which was critical to the project, even if I could not monitor them	1	2	3	4	5	6	7
28. I received the information needed to do my job from the owner in a timely manner.	1	2	3	4	5	6	7
29. I received incompatible requests about this project from two or more people.	1	2	3	4	5	6	7
30. I received an assignment without adequate resources and materials to execute it.	1	2	3	4	5	6	7
31. I often found myself involved in situations in which there were conflicting requirements.	1	2	3	4	5	6	7
32. I didn't know what was expected of me as a member of this team.	1	2	3	4	5	6	7
33. Explanations were clear of what had to be done as a member of this team	1	2	3	4	5	6	7
34. Conflicts about this project were handled appropriately through proper communication channels.	1	2	3	4	5	6	7

	Strongly Disagree		Neutral			Strongly Agree	
	1	2	3	4	5	6	7
35. I felt that my firms project team worked well together.							
36. Communication practices between owner and contractor were adaptable to emergencies.	1	2	3	4	5	6	7
37. I felt that the combined owner and contractor companies involved in this project worked well together.	1	2	3	4	5	6	7
38. I look forward to working with this owner in the future	1	2	3	4	5	6	7
39. I look forward to working with the people from this owner in the future.	1	2	3	4	5	6	7
40. I felt that the project team used its resources effectively.	1	2	3	4	5	6	7
41. I felt that the project team accomplished its goals in a timely manner.	1	2	3	4	5	6	7
42. I felt that the project team rapidly and effectively solved problems.	1	2	3	4	5	6	7
43. Did the project team discover new methods of communicating with each other?							
a. Yes							
b. No							
If yes, please describe _____							

What communications methods did the project team regularly use? _____							

44. Did the project team develop new methods for managing meetings?							
a. Yes							
b. No							
If yes, please describe _____							

45. Did the project team develop new methods for scheduling activities during projects?

- a. Yes
- b. No

If yes, please describe _____

What scheduling tool did you use? _____

46. Did the project team discover new ways of coordinating among team members?

- a. Yes
- b. No

If yes, please describe _____

47. Did the project team have a debriefing session of the entire project team, in which the team assessed any lessons learned during the project?

- a. Yes
- b. No

If yes, please describe _____

48. If so, was any information gained from this debriefing recorded in some form for future retrieval?

- a. Yes
- b. No

If yes, please describe _____

49. Has any information gained from this debriefing been integrated into future projects?

- a. Yes
- b. No

If yes, please describe _____

50. Please indicate the planned and actual schedule for the project in the table below (If the records are not available, please provide your best estimate of this information).

Project Phase	Planned Schedule		Actual Schedule	
	Start (mm/dd/yy)	Stop (mm/dd/yy)	Start (mm/dd/yy)	Stop (mm/dd/yy)
Pre-Project Planning				
Detailed Design				
Procurement				
Construction				
Startup				

51. Please indicate the budgeted and actual costs for the project by project phase.

Project Phase	Phase Budget (Including Contingency)	Amount of Contingency in Budget	Actual Phase Cost
Pre-Project Planning	\$	\$	\$
Detailed Design	\$	\$	\$
Procurement	\$	\$	\$
Construction	\$	\$	\$
Startup	\$	\$	\$
Total Project Cost	\$	\$	\$

52. What was the total value of change orders in dollars for this project?

\$_____ of change orders

53. What was your percent of planned capacity at six months? Planned capacity refers to the nominal rate of the facility, which is used during engineering and design to size equipment and mechanical and electrical systems. Nominal rate may be expressed in tons per year, barrels per day, kilowatts, etc. For infrastructure or buildings please use the measure of planned capacity that you feel is best.

_____ % of planned capacity at six months

If the achieved capacity is much worse or much better than expected, please briefly comment on the primary causes of the deviation.

54. Please indicate how the achieved capacity of the completed facility compares against expectations *documented in the project execution plan.*

Much worse than expected				As expected			Much better than expected
	1	2	3		5	6	
				4			7

55. Indicate the success of the working relationship with this owner firm on this project.

Not at all successful				Moderately successful		Very successful
	1	2	3		5	
				4		6
						7

56. Please rate the following list of relationship indicators based on their importance to the success of an owner-contractor relationship. (Please use a scale of 1 to 7, where 1 is the most important and 7 is the least important.)

Attribute	Definition	Rating
Contractor meets owner's Project objectives	The project is delivered on or ahead of schedule and budget targets with minimal rework in the field. Startup is smooth.	
Contractor understands owner's business	Contractor personnel understand owner's business objectives and operating systems and procedures	
Integration of owner and contractor personnel	Owner and contractor work together repeatedly, using many of the same personnel from project to project. Owner and contractor develop effective communication structures, a shared vocabulary, and a common project culture. Owner and contractor systems are integrated to the extent possible. Trust develops between owner and contractor personnel. Multiple levels of personnel are involved in both the owner and contractor organization	
Contractor responsiveness to changing conditions	Contractor responds quickly and effectively to owner needs Contractor informs owner as early as possible about upcoming difficulties	
Contractor willingness to innovate	Contractor is willing to challenge owner ideas, recommend improvements, and take risks.	
Operating for mutual benefit	The relationship benefits both owner and contractor. Gains made through a productive relationship, such as cost savings, are shared between owner and contractor.	
Learning from the relationship is documented and used	Owner and contractor explicitly discuss and document the lessons learned from each project. If possible, these lessons are integrated into systems and procedures that can be reused on subsequent projects.	

VI. Please tell us about your experiences with your employer. While answering these questions, please consider more than the current project unless otherwise specified.

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
1. I feel no need to defend this project when coworkers not involved in the project criticize it.	1	2	3	4	5	6	7	
2. I do not feel like "part of the family" at this company.	1	2	3	4	5	6	7	
3. My company rewards me fairly for the <i>amount of effort</i> that I put forth.	1	2	3	4	5	6	7	
4. When someone praises this project, it feels like a personal compliment.	1	2	3	4	5	6	7	
5. I would not recommend my job to a friend.	1	2	3	4	5	6	7	
6. This company has a great deal of personal meaning for me.	1	2	3	4	5	6	7	
7. The success or failure of my company in the long run is unimportant to me.	1	2	3	4	5	6	7	
8. I am planning to search for a new job during the next 12 months.	1	2	3	4	5	6	7	
9. When someone criticizes my company it feels like a personal insult.	1	2	3	4	5	6	7	
10. The owner's successes are my successes.	1	2	3	4	5	6	7	
11. I do not feel a strong sense of belonging to this company.	1	2	3	4	5	6	7	
12. My company rewards me fairly in view of the <i>amount of experience</i> that I have.	1	2	3	4	5	6	7	
13. I frequently think of quitting my job.	1	2	3	4	5	6	7	
14. I would be very happy to spend the rest of my career with this company.	1	2	3	4	5	6	7	

	Strongly Disagree			Neutral			Strongly Agree	
	1	2	3	4	5	6	7	
15. The general procedures used to evaluate my promotability are fair.								
16. Knowing what I know now, if I had to decide all over again, I would still take my current job.	1	2	3	4	5	6	7	
17. Generally speaking, I am satisfied with my job.	1	2	3	4	5	6	7	
18. If the owner is viewed well by others in my organization is unimportant to me.	1	2	3	4	5	6	7	
19. I really feel as if this company's problems are my own.	1	2	3	4	5	6	7	
20. The general procedures used to determine my pay increases are fair.	1	2	3	4	5	6	7	
21. I am very interested in what others think about my company.	1	2	3	4	5	6	7	
22. My company rewards me fairly considering the responsibilities that I have.	1	2	3	4	5	6	7	
23. I do not feel "emotionally attached" to this company.	1	2	3	4	5	6	7	
24. My job does not measure up to the sort of job I wanted when I took it.	1	2	3	4	5	6	7	
25. The general procedures used to evaluate my performance are fair.	1	2	3	4	5	6	7	
26. When I talk about the owner I usually say "we" rather than "they."	1	2	3	4	5	6	7	

VII. How well do the statements below describe your experience with this owner.

	Strongly Disagree		Neutral			Strongly Agree	
	1	2	3	4	5	6	7
1. We are the primary source of design, engineering and/or construction management services for this owner.	1	2	3	4	5	6	7
2. This owner is requesting that we supply a more diversified assortment of services.	1	2	3	4	5	6	7
3. Our organizational cultures are strongly aligned.	1	2	3	4	5	6	7
4. We entered our relationship with a strong-shared vision.	1	2	3	4	5	6	7
5. We meet regularly to address emerging issues.	1	2	3	4	5	6	7
6. We defined specific goals for our relationship.	1	2	3	4	5	6	7
7. The owner actively participates in the capital facility project process.	1	2	3	4	5	6	7
8. We evaluate our relationship performance against our goals on a regular basis.	1	2	3	4	5	6	7
9. We focus on learning and continuous improvement.	1	2	3	4	5	6	7
10. The owner understands the capital facility project design and construction process.	1	2	3	4	5	6	7
11. The owner provides positive feedback on our performance on a regular basis.	1	2	3	4	5	6	7
12. There is a budget set up to cover the internal costs of maintaining and developing this owner relationship.	1	2	3	4	5	6	7

Please explain your answer to any question that you rated 1 or 2.

VIII. Please tell us about the changes that have occurred in the construction industry over the past 5 years and what you anticipate will change in the construction industry in the next 3 years.

1. What do you think are the most significant changes in the construction industry in the past 5 years?

2. What do you think will be the most significant changes in the construction industry in the next 3 years?

3. Please rate the following list of skills and traits based on their importance to the ability of:
a) contractor personnel in a key project position to successfully fulfill their duties and responsibilities?
b) owner personnel in a key project position to successfully fulfill their duties and responsibilities?

(Please use a scale of 1 to 10, where 1 is the most important and 10 is the least important.)

Trait	Definition	Contractor	Owner
Agreeableness	Ability to get along with others and be open minded to new ideas.		
Assertiveness	Willing to take risks and aggressively pursue a goal to its completion.		
Confidence	Trust in one's own ability to perform the required tasks and in the abilities of others to fulfill their responsibilities.		
Conscientiousness	Perseverance, responsibility, and thoroughness in completing task.		
Judgment	Ability to differentiate between trivial and important details. Awareness of abilities and limitations of people and ideas.		
Trustworthiness	Personal integrity and honesty. Ability to inspire others to have trust in one's self.		
Business Skills	Writing and managing contracts, Negotiation, Managing budgets and schedules.		
Communication Skills	Coordination/liaison, Conflict management. Cultivate broad network of relationships.		
Influence Skills	Mentoring, Motivating, Change management.		
Managerial Skills	Team building, Delegating, Politically aware/see big picture.		
Problem Solving Skills	Continually analyze options/innovation, Planning, Consider both sides of issues, risk management.		
Technical Skills	Understand entire construction process, Multi-disciplined (knowledge of several areas of engineering), Information technology skills.		

Thank you for your participation!!

Appendix E: Selected Project Manager Survey Comments

What do you think are the most significant changes in the construction industry in the past 5 years?

Management

More project risks and liabilities are being passed down to the contractor

Increased use of EPC and Fast Track project approach to construction

Owner organizations are downsizing

Level of project experience has dramatically decreased for both owner and contractor organizations

Increased use of mid-management project managers between the owner-contractor organizations

The lack of new tradesman entering the workforce, in turn which is leading to a decrease in quality of work and causing budgets and schedules to be affected

Less personal commitment

Smaller companies are able to execute all but the MEGA projects in the US

Increased use of Design Build projects due to its ability to impact schedules

Project Manager

Loss of skilled labor

Increase in per diem to attract additional resources

Contractors are sharing more risk with the owners

Use of computer technology has increased

Safety awareness has increased

Recognition of contractor staff as professionals

Degradation of design documents

Owner requirement of “faster and cheaper” projects

Manpower resources not readily available

Loss of skilled crafts

Increased use of pre-project planning-construction sequencing

Increased use of preferred provider vice winning bid

Increased use of team building

Use of integrated teams to cut costs

A shift to primarily a service organization

Outsourcing most services or organization

Globalization of staff to manage work

What do you think will be the most significant changes in the construction industry in the next 3 years?

Management

More project risks and liabilities will be passed down to the contractor

Significant project schedule compression and additional administrative requirements placed on contractor

Increased owner contractor alliances

Single point fully capability contract requirements

EPC and Design-Build trend will continue to grow

Increased use of turn-key work will continue to grow; E-commerce will become apart of contractor's business

Project Manager

Continued growth of turn-key strategy

Continued increase and use of electronic information

To success in the industry exchange of information will require the contractor to be a "24 hour" engineer

As foreign firms increase in numbers the work will go overseas

Forms of communication will change

Use of Design-Build will increase and project budget will decrease

Increased failure of companies who fail to adapt; Consolidation of owner-contractor companies

Globalization of companies and workforce

Paperless administrative requirements are rapidly changing durations of projects

Increased use of negotiated bidding

Labor shortages

More trust and alliances between companies (owner-contractor), Increase in the use of EPC contracts

Labor wage increases to attract craft laborers

Appendix F: Raw Data

Human Resources Data																								
	POSITION	APPS	A2	B2	C2	D2	E2	F2	G2	A3	B3	C3	D3	E3	F3	A4	METHOD4A	B4	METHOD4B	C4	METHOD4C	D4	METHOD4D	
pc pc pcm pcm pcm pcm ped ped ped		2	7	7	4	5	3	3	6	7	2	1	1	3	7.00	1.00		3	1.00	3.00	2.00	*!	1.00	3.00
		5	5	5	4	6	6	6	7	5	3	2	1	5	*!	2.00		2	1.00	2.00	1.00		2.00	1.00
		3	4	7	5	7	5	1	7	6	7	5	6	7	7.00	1.00		2	1.00	2.00	2.00		*!	1.00
		3	6	7	7	7	4	2	6	7	5	1	1	2	6.00	1.00		4	2.00		*!	1.00	4.00	
		5	2	7	7	7	5	3	6	6	6	5	6	5	*!	1.00		1	1.00	1.00	1.00		1.00	
		3	5	6	6	7	5	4	6	5	6	1	1	3	*!	1.00		2	1.00	2.00	1.00		2.00	
		20	6	6	4	6	5	2	6	6	2	1	1	2	*!	2.00		*!	2.00		*!	2.00		
		*!	4	6	6	6	3	1	6	4	4	*!	*!	*!	*!	1.00		*!	1.00		*!	1.00		
		2	3	7	4	6	3	2	6	2	7	1	1	5	*!	1.00		2	.00		*!	.00		
	3	6	6	6	4	2	7	6	6	1	1	1	*!	1.00		4	1.00		4.00	1.00		4.00		
	3	7	2	6	6	4	2	7	6	1	1	1	1	*!	1.00		2	2.00		1.00	2.00		*!	

E4	METHOD4E	F4	METHOD4F	G4	METHOD4G	PA1	PA2	PA3A	PA3AWEIG	PA3B	PA3BWEIG
1.00	3.00	1.00	3.00	*!	*!	1.00	1.00	experience	.50	mgt skill	.20
1.00	2.00	1.00	2.00	*!	*!	1.00	1.00	business acumen	*!	client/colleague	*!
2.00	*!	1.00	2.00	1.00	*!	1.00	1.00		*!		*!
2.00	*!	2.00	*!	*!	*!	1.00	1.00				
1.00	1.00	1.00	1.00	*!	*!	.05	1.00		*!		*!
1.00	2.00	1.00	2.00	*!	*!	1.00	1.00		*!		*!
2.00	*!	2.00	*!	*!	*!	.00	.00	no criteria	*!	no criteria	*!
1.00	*!	1.00	*!	*!	*!	1.00	*!		*!		*!
1.00	2.00	1.00	3.00	*!	*!	.85	.00	adaptability	.11	attitude	.11
1.00	4.00	*!	4.00	*!	*!	1.00	.00	quality	*!	quantity	*!
*!	*!	*!	*!	*!	*!	1.00	1.00	client goals	*!	prof goals	*!

PA3C	PA3CWEIG	PA3D	PA3DWEIG	PA3E	PA3EWEIG	PA3F	PA3FWEIG	T1AN	T1AA	T1BN
tech skill	.10	leadership	.10					*!	3.00	.50
communication	*!	team effort	*!	creat/innovate		delegation		*!	2.00	2.00
	*!		*!					*!	2.00	2.00
	*!		*!					*!	3.00	4.00
	*!		*!					*!	.00	*!
	*!		*!					*!	*!	5.00
no criteria	*!	no criteria	*!	no criteria		no criteria		*!	*!	*!
	*!		*!					*!	.00	1.00
client focus	.11	comm awareness	.11	accountability	.11	communication	.11	.00	1.00	.00
job knowledge	*!	initiative	*!	att/relationshi		leadership		*!	*!	*!
busin dev goal	*!	leadership	*!					*!	2.00	1.00

T1BA	T1CN	T1CA	T1DN	T1DA	T1EN	T1EA	T1FN	T1FA	T1G	T1GN	T1GA	C1A	C1B	C1C	C1D	C1E	C2APM
.50	.50	.50	.50	.50	.25	.50	.25				*!	*!	*!	1.00	1.00	*!	.80
.00	.00	.00	2.00	2.00	2.00	2.00	10.00	15.00			*!	*!	*!	1.00	1.00	*!	.50
.00	3.00	2.00	1.00	1.00	.00	.00	2.00	2.00	IT skills	2.00	1.00	*!	1.00	1.00	*!	*!	1.00
3.00	1.00	4.00	.00	4.00	.00	3.00	5.00	5.00			*!	*!	1.00	1.00	1.00	*!	.90
*!	.00	*!	.00	*!	.00	*!	100.00	*!	leadership	4.00	4.00	*!	1.00	1.00	*!	1.00	.70
5.00	*!	5.00	*!	5.00	*!	5.00	*!	5.00			*!	*!	*!	1.00	1.00	*!	.20
*!	*!	*!	*!	*!	*!	*!	*!	4.00	safety	1.00	12.00	*!	1.00	1.00	*!	*!	1.00
*!	.00	1.00	.00	1.00	.00	1.00	1.00	1.00			*!	*!	1.00	1.00	*!	*!	.50
.50	.00	.50	.00	2.00	.00	.50	3.00	3.00			*!	*!	*!	1.00	1.00	*!	.95
*!	*!	*!	*!	*!	*!	*!	*!	*!	total	5.00	5.00	*!	1.00	1.00	1.00	1.00	.50
1.00	1.00	1.00	1.00	2.00	1.00	1.00	3.00	3.00			*!	*!	1.00	1.00	1.00	*!	*!

Human Resources Data	C2APE	C2BPM	C2BPE	C2CPM	C2CPE	C2DPM	C2DPE	CP1A	CP1ATIME	CP1AWITH	CP1B	CP1BTIME
	.80	.10	.10	*!	*!	.10	.10	proj engr	6.00	.70	proj mgr	10.00
	.50	.50	.50	*!	*!	*!	*!	staff arch ehqr	5.00	.00	sr staff arch	7.00
	1.00	*!	*!	*!	*!	*!	*!		*!	*!		*!
	.95	.08	.04	.02	.01	.00	.00	asst engr	2.00	.05	enqr	2.00
	*!	.30	*!	*!	*!	*!	*!	proj coordinato	*!	*!	asst proj mgr	*!
	*!	.50	*!	.20	*!	.15	*!	disc field engr	5.00	*!	lead field engr	2.00
	1.00	*!	*!	*!	*!	*!	*!	proj engr	5.00	.00	proj mgr	10.00
	.75	.50	.25	*!	*!	*!	*!		*!	*!		*!
	.98	.05	.02	.00	.00	.00	.00	enqr I	2.00	.00	enqr II	3.00
	.80	.50	.20	*!	*!	*!	*!	enqr I-V	15.00	.80	supv disc.enqr	4.00
	*!	.60	*!	.40	1.00	*!	*!	enqr I	1.00	.00	enqr II	2.00

Human Resources Data	CP1BWITH	CP1C	CP1CTIME	CP1CWITH	CP1D	CP1DTIME	CP1DWITH	CP1E	CP1ETIME
	.50	proj mgr	15.00	.30		*!	*!		*!
	*!	sr proj	7.00	*!	manager	*!	*!	design dir	*!
	*!		*!	*!		*!	*!		*!
	.80	proj engr	3.00	.75	proj mgr	3.00	.75	proj exec	1.00
	*!	proj mgr	*!	*!	sr proj mgr	*!	*!	bus unit mgr	*!
	*!	enqr mgr	2.00	*!	constr mgr	3.00	*!	site mgr	5.00
	.75	construction mg	5.00	.90		*!	*!		*!
	*!		*!	*!		*!	*!		*!
	.98	enqr III	3.00	.90	sr engr	10.00	.80	prin engr	10.00
	.80	proj engr PE	7.00	.80	proj mgr	7.00	.85	sr pm	*!
	.80	enqr III	3.00	.75	sr engr	8.00	.65		*!

Human Resources Data	CP1EWITH	CP2	AGE29	AGE29M	AGE39	AGE39M	AGE49	AGE49M	AGE59	AGE59M	AGE69	AGE69M	AGE70	AGE70M
	*!	proj mgr	.01	.67	.19	.82	.38	.83	.34	.93	.08	.87	.00	*!
	*!	director	.23	.64	.42	.88	.27	.85	.08	.88	.00	.00	.00	.00
	*!	construction mg	.10	1.00	.10	.75	.15	1.00	.63	1.00	.02	1.00	.00	.00
	.90	proj exec	.25	.80	.32	.85	.25	.96	.10	1.00	.02	1.00	.00	.00
	*!		.15	*!	.42	*!	.29	*!	.13	*!	.01	*!	.00	*!
	*!	site mgr	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	construction mg	.00	.00	1.00	1.00	3.00	1.00	1.00	1.00	*!	*!	*!	*!
	*!		.20	.80	.30	.90	.40	.90	.10	.90	.00	.00	.00	.00
	.75		.10	.87	.16	.79	.24	.89	.32	1.00	.16	1.00	.02	1.00
	.90	proj engr mgr	.00	.00	.12	1.00	.54	.86	.31	1.00	.04	1.00	.00	.00
	*!		.10	.60	.20	.80	.30	.90	.25	.95	.15	1.00	.00	.00

Project Manager Data

	DEGREE	YEAR	FULLTIME	CURRENT	TITLEYRS	EMPOWNER	OWNER	OWNERYRS	CLASS	STATE	II3	II4	II5	II6	II7	II8	II9	II10	II11	II12	II13	II14	II15		
b		1980	19.90	5.50	3.00	.00	■	■	cr1	TX				■							66.00	.00	■	■	4.00
■	■	23.00	18.00	3.00	.00	■	■	cr2					■			■					2.00	.00	■	■	8.00
b		1991	11.00	8.00	1.00	.00	■	■	nr1					■			■				1.00	.00	■	■	10.00
c		1991	11.00	8.00	1.00	.00	■	■	nr2					■			■				.00	.00	■	■	6.00
b		1978	22.00	11.00	4.00	1.00	1.00	11.00	cr1	IN	c	b	a	5.00	a	e	e	■			1.00	2.00	■	■	800.00
b		1981	19.00	4.00	2.00	2.00	■	■	nr1	TN	c	b	d	4.00	a	c	b	6.00	1	9	3.00	2.00	■	■	18.00
c		1985	33.00	5.00	10.00	2.00	■	■	cr1	KY	r	b	f	4.00	a	e	d	■			1.00	2.00	■	■	70.00
b		1980	20.00	9.00	3.00	2.00	■	■	nr1	NJ	d	a	a	6.00	b	a	e	■			1.00	2.00	■	■	■
c		1971	37.00	32.00	5.00	1.00	1.00	3.00	nr2	NY	r	d	g	7.00	b	b	d	■			1.00	1.00	2.00	■	120.00
a		1974	30.00	12.00	4.00	1.00	3.00	18.00	cr1	NY	r	b	d	7.00	b	b	d	■			1.00	2.00	■	■	132.00
b		1988	12.00	12.00	4.00	.00	■	■	cr1					■			■				5.00	.00	■	■	40.00
b		1979	21.00	19.00	4.00	.00	■	■	cr1	TX	h	a	f	6.00	a	c	b	9.00	0		.00	.00	■	■	7.00
b		1967	33.00	3.00	3.00	.00	■	■	cr1	AL	d	b	ab	5.00	b	d	a	7.00	b		2.00	.00	■	■	135.00
c		1987	21.00	8.00	3.00	1.00	1.00	13.00	nr1					■			■				2.00	.00	■	■	50.00
b		1974	26.00	25.00	4.00	.00	■	■	nr2					■			■				.00	.00	■	■	100.00
b		1971	29.00	7.00	4.00	.00	■	■	cr2					■			■				4.00	.00	■	■	110.00
■	■	30.00	8.00	3.00	1.00	2.00	10.00	cr1	WV	d	b	b	e	7.00	b	d	a	15.00	1	1	25.00	2.00	■	■	60.00
b		1977	23.00	23.00	.50	2.00	■	■	cr2	KY	l	b	g	4.00	b	e	a	5.00	2	6	4.00	2.00	■	■	■
c		1982	26.00	25.00	17.00	2.00	■	■	cr1	OH	d	b	g	5.00	b	e	b	14.00	1	9	4.00	2.00	■	■	220.00
b		1964	36.00	12.00	1.00	1.00	1.00	10.00	cr1	NC	c	b	a	6.00	a	e	c	20.00	1	1	2.00	1.00	2.00	■	390.00
b		1972	23.00	22.00	8.00	2.00	■	■	cr2	NC	r	b	g	5.00	a	d	c	5.00	1	5	2.00	2.00	■	■	170.00
c		1994	25.00	11.00	6.00	1.00	1.00	2.00	cr1	NC	r	e	d	7.00	a	d	c	5.00	1	3	2.00	2.00	■	■	250.00
b		1979	20.00	5.00	2.00	2.00	■	■	nr1	NY	l	b	g	3.00	b	c	d	■			18.00	2.00	■	■	■
b		1996	4.50	4.50	.50	2.00	■	■	cr1	NY	l	b	g	4.00	a	e	c	20.00	2	4	15.00	2.00	■	■	1.50
■	■	■	■	■	■	■	■	■	cr1	TX	h	b	d	7.00	b	a	c	15.00	1	4	3.00	.00	■	■	85.00
■	■	40.00	38.00	25.00	.00	■	■	cr1	TX	h	b	d	5.00	b	e	c	20.00	1	7	2.00	.00	■	■	25.00	
■	■	18.00	18.00	2.00	.00	■	■	nr1	TX	h	e	ac	5.00	b	a	c	4.00	0	6	1.00	.00	■	■	25.00	
■	■	23.00	22.00	.25	.00	■	■	nr1	TX	h	a	ac	5.00	b	a	d	4.00	1	3	1.00	.00	■	■	20.00	
■	■	26.00	10.00	3.00	1.00	6.00	16.00	nr2	TX	r	a	g	4.00	b	a	d	■				1.00	.00	■	■	20.00
■	■	18.00	18.00	2.00	.00	■	■	nr2	TX	r	a	g	5.00	b	a	d	2.00	0	6	1.00	.00	■	■	28.00	
b		1985	15.00	3.50	2.00	2.00	■	■	nr1	CA	h	b	a	6.00	b	e	■				.00	2.00	■	■	6.00
b		1975	25.00	25.00	4.00	2.00	■	■	nr2	CA	k	a	g	4.00	b	e	■				1.00	2.00	■	■	10.00
b		1981	30.00	20.00	1.00	■	■	■	cr1	CA	l	d	g	5.00	b	e	a	10.00	1	1	10.00	2.00	■	■	25.00
b		1981	20.00	13.00	1.50	1.00	1.00	2.00	cr2	NY	r	b	g	2.00	d	b	3.00	1	5	6.00	2.00	■	■	4.00	
■	■	42.00	25.00	10.00	1.00	1.00	2.00	cr1	IL	h	a	g	7.00	e	c	30.00	1	4	6.00	2.00	■	■	70.00		
■	■	32.00	32.00	15.00	2.00	■	■	nr1	CA	d	b	g	4.00	b	c	d	■	2			2.00	2.00	■	■	750.00
■	■	32.00	32.00	15.00	2.00	■	■	nr2	TX	d	a	g	4.00	b	c	d	■				1.00	2.00	■	■	500.00

II16	IV1	IV1A	IV1A1	IV1A2	IV1A3	IV1A4	IV1A5	IV1B	IV1B1	IV1B2	IV1B3	IV1B4	IV1B5
■	7.00		owner rep	1.00	1.00	1.00	1.00		user rep	1.00	1.00	1.00	1.00
3.00	3.00	VP Real Est		1.00	1.00	1.00	.00	proj mgr		1.00	1.00	.00	.00
10.00	3.00	Manager		1.00	1.00	1.00	.00	President		1.00	1.00	1.00	.00
6.00	4.00		owner rep	1.00	.00	1.00	.00		rep rep	.00	1.00	.00	.00
7.00	3.00	proj mgr	owner rep	1.00	1.00	1.00	2.00		onsite coord	1.00	1.00	1.00	2.00
6.00	3.00	Proj Mgr	owner rep	1.00	1.00	1.00	1.00	Elec Engr		2.00	2.00	1.00	2.00
■	3.00	Proj Dir	finance	1.00	1.00	2.00	2.00	Project Manager	coordination	1.00	1.00	1.00	2.00
7.00	3.00	owner	owner	1.00	1.00	1.00	2.00	Director	owner liaison	1.00	1.00	1.00	2.00
6.00	9.00	Proj Mgr	proj overview	1.00	1.00	1.00	2.00	Contracts Mgr	contractcts, COs	1.00	1.00	1.00	2.00
8.00	6.00	dir of const	total project	1.00	1.00	1.00	1.00	const mgr		1.00	1.00	1.00	2.00
10.00	4.00	dir of fac	owner	1.00	1.00	11.00	.00	lead user conta	user rep	1.00	1.00	1.00	.00
7.00	3.00	proj mgr	owner liason	1.00	1.00	1.00	1.00	real estate mgr	ovner	.00	1.00	1.00	1.00
■	4.00	proj mgr	owner	1.00	1.00	1.00	.00	proj leader		1.00	1.00	1.00	.00
5.00	5.00	CEO	1	1.00	1.00	1.00	.00	Proj Mgr		1.00	1.00	1.00	.00
6.00	3.00	Proj mgr		1.00	1.00	1.00	.00	Operations Rep		1.00	1.00	1.00	.00
7.00	3.00	Process Lead		1.00	1.00	1.00	.00	PCS Lead		1.00	1.00	1.00	.00
10.00	5.00	Project Lead	total project	1.00	1.00	1.00	2.00	Tech support	process technol	2.00	1.00	1.00	2.00
10.00	8.00	Project Mgr	total project	1.00	1.00	2.00	1.00	Elec Liason	coordinate elec	1.00	1.00	1.00	1.00
6.00	3.00	Project DFP	Dept Head	1.00	1.00	1.00	1.00	Proj Engr	Proj Lead	1.00	1.00	1.00	1.00
16.00	7.00	Capital Mgr	project financi	1.00	2.00	2.00	2.00	Proj Mgr	total proj	1.00	1.00	1.00	2.00
4.00	3.00	Proj Mgr	total proj	1.00	1.00	1.00	2.00	Vendor Team Lea	tech/design inp	1.00	1.00	1.00	2.00
5.00	4.00	Proj Mgr		1.00	1.00	1.00	2.00	Vendor Team Lea	owner rep desig	1.00	1.00	1.00	2.00
6.00	6.00	Director	head of org	1.00	1.00	1.00	2.00	Assoc Dir	aesthetics	1.00	1.00	1.00	2.00
4.00	1.00			1.00	1.00	■	1.00			■	■	■	■
10.00	2.00	proj mgr	owner	1.00	1.00	.00	.00	rep coord	rep design	1.00	1.00	.00	.00
4.00	2.00	proj mgr	owner	1.00	1.00	1.00	1.00	asst pm	asst pm	1.00	1.00	1.00	1.00
9.00	1.00	Owner's rep		1.00	1.00	1.00	.00			■	■	■	■
6.00	2.00	Owner's rep		.00	1.00	1.00	.00		owner's consult	1.00	1.00	1.00	.00
8.00	■			■	■	■	■			■	■	■	■
10.00	■			■	■	■	■			■	■	■	■
6.00	4.00	Proj Mgr	construction	1.00	1.00	2.00	2.00	Proj Mgr #2	const mgt	1.00	2.00	2.00	2.00
10.00	6.00	VP Real Esta	owner rep	1.00	1.00	1.00	2.00	Fac Mgr	bidg mgt	1.00	1.00	1.00	2.00
5.00	2.00	Proj Dir	owner rep	1.00	1.00	1.00	2.00	asst dir	site owners rep	1.00	1.00	1.00	2.00
4.00	2.00	Proj Mgr	schedule/cost	1.00	1.00	2.00	2.00	CM	Constr Mgr	1.00	1.00	1.00	2.00
6.00	2.00	Proj Mgr	contract mgt	1.00	1.00	1.00	2.00	asst Proj Mgr	prod mgt	1.00	1.00	1.00	2.00
9.00	10.00	Proj Mgr	overall proj	1.00	1.00	1.00	2.00	Engr Mgr	design team	1.00	1.00	2.00	1.00
9.00	7.00	Proj Mgr	overall proj	1.00	1.00	1.00	2.00	Eng Mgr	design	1.00	1.00	1.00	2.00

	IVIC	IVIC1	IVIC2	IVIC3	IVIC4	IVIC5	IV2	IV3	V1A	V1B	V1C	V1D	V1E	V1F	V1G	V2	V3A	V3B	V4A	V4B	V4C	V4D	V4E	V4F
Project Manager Data		architect	1.00	1.00	1.00	1.00	d	a	2.00	3.00	4.00	7.00	7.00	7.00	3.00	.00	3.00	4.00	2.00	2.00	2.00	2.00	1.00	.00
	proi mgr		1.00	.00	.00	.00	c	c	2.00	5.00	5.00	7.00	7.00	7.00	4.00	1.00	7.00	7.00	4.00	6.00	5.00	.00	6.00	7.00
	Controller		1.00	1.00	1.00	.00	b	b	1.00	1.00	4.00	7.00	7.00	7.00	1.00	1.00	1.00	1.00	4.00	4.00	4.00	.00	5.00	.00
		bldg maintenanc	1.00	.00	1.00	.00	d	a	5.00	4.00	3.00	6.00	7.00	6.00	1.00	1.00	5.00	3.00	6.00	6.00	6.00	.00	1.00	4.00
	bus unit mgr		1.00	1.00	1.00	2.00	d	b	7.00	7.00	7.00	7.00	7.00	7.00	4.00	1.00	5.00	5.00	4.00	7.00	1.00	3.00	2.00	3.00
	process engr	process scope	2.00	2.00	1.00	2.00	d	c	6.00	6.00	7.00	7.00	7.00	7.00	2.00	2.00	2.00	4.00	4.00	6.00	4.00	3.00	6.00	.00
	Area Proi Mgr	process scope	1.00	1.00	1.00	2.00	d	a	1.00	1.00	6.00	2.00	7.00	7.00	2.00	1.00	2.00	2.00	5.00	7.00	3.00	.00	5.00	6.00
	Plant Manager	plant ops	1.00	2.00	1.00	2.00	d	b	7.00	5.00	6.00	7.00	7.00	7.00	1.00	2.00	6.00	4.00	7.00	7.00	6.00	.00	6.00	.00
	Schedule Engr	schedule	1.00	1.00	1.00	2.00	b	c	1.00	1.00	1.00	1.00	7.00	3.00	1.00	1.00	4.00	4.00	7.00	7.00	4.00	.00	6.00	7.00
	proi engr		1.00	1.00	1.00	2.00	d	c	1.00	1.00	2.00	2.00	7.00	5.00	1.00	2.00	5.00	.00	.00	.00	.00	.00	.00	.00
	lead user conta	user rep	1.00	1.00	1.00	.00	d	c	7.00	7.00	7.00	7.00	7.00	7.00	3.00	1.00	6.00	7.00	.00	7.00	7.00	7.00	4.00	7.00
		site mgr	1.00	1.00	1.00	1.00	a	b	6.00	5.00	4.00	6.00	6.00	5.00	3.00	.00	5.00	5.00	5.00	5.00	3.00	2.00	3.00	4.00
	constr res engr		1.00	1.00	1.00	.00	d	a	7.00	7.00	7.00	7.00	1.00	1.00	1.00	1.00	6.00	7.00	3.00	7.00	2.00	2.00	5.00	6.00
	Contract Mrg		1.00	1.00	1.00	.00	c	a	4.00	4.00	7.00	7.00	7.00	6.00	6.00	.00	6.00	6.00	5.00	7.00	5.00	5.00	7.00	5.00
	I&E		1.00	1.00	1.00	.00	b	b	4.00	1.00	7.00	7.00	7.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
	proi mgr		1.00	1.00	1.00	.00	a	a	3.00	4.00	7.00	5.00	7.00	1.00	1.00	1.00	4.00	3.00	3.00	6.00	3.00	3.00	6.00	.00
	Constr Engr	const agt	1.00	1.00	1.00	2.00	c	a	6.00	7.00	5.00	6.00	7.00	6.00	6.00	1.00	6.00	6.00	7.00	7.00	7.00	6.00	7.00	.00
	plant reps	define scope	1.00	1.00	1.00	2.00	a	c	1.00	6.00	7.00	4.00	2.00	2.00	1.00	1.00	4.00	4.00	4.00	4.00	3.00	2.00	3.00	.00
	Field Coord	plant interface	1.00	1.00	1.00	1.00	b	a	3.00	3.00	1.00	4.00	7.00	6.00	1.00	5.00	6.00	5.00	6.00	5.00	3.00	4.00	2.00	.00
	Proi Engr	design coord	1.00	1.00	2.00	1.00	c	b	7.00	7.00	7.00	7.00	7.00	7.00	4.00	2.00	5.00	6.00	7.00	7.00	5.00	4.00	7.00	7.00
	owner rep	field oversight	1.00	1.00	1.00	1.00	a	a	1.00	4.00	7.00	7.00	7.00	7.00	1.00	2.00	3.00	5.00	3.00	7.00	2.00	3.00	7.00	7.00
	Const Mrg	owner rep const	1.00	1.00	1.00	2.00	c	a	2.00	2.00	7.00	7.00	7.00	7.00	4.00	2.00	4.00	4.00	2.00	7.00	2.00	2.00	4.00	6.00
	Purchasing	purchasin	1.00	1.00	1.00	2.00	d	b	7.00	7.00	7.00	6.00	6.00	5.00	1.00	2.00	6.00	6.00	.00	5.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
			.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	
		.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00</									

Project Manager Data		V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32	V33	V34	V35	V36	V37	V38	V39	V40	V41	V42	V43	V44	V45
		7.00	7.00	7.00	7.00	6.00	7.00	1.00	2.00	7.00	7.00	7.00	5.00	2.00	1.00	5.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		6.00	6.00	7.00	7.00	5.00	6.00	2.00	2.00	7.00	5.00	6.00	7.00	7.00	2.00	6.00	1.00	7.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		5.00	7.00	5.00	6.00	6.00	6.00	4.00	1.00	7.00	4.00	5.00	1.00	1.00	4.00	7.00	1.00	6.00	5.00	7.00	7.00	4.00	1.00	6.00	4.00	6.00	6.00	6.00	1.00	0.00
		5.00	7.00	5.00	2.00	1.00	5.00	2.00	3.00	6.00	4.00	6.00	5.00	7.00	5.00	7.00	5.00	3.00	3.00	5.00	5.00	6.00	6.00	6.00	5.00	6.00	2.00	0.00	0.00	1.00
		4.00	7.00	5.00	6.00	2.00	4.00	2.00	2.00	6.00	3.00	5.00	5.00	5.00	2.00	5.00	2.00	6.00	5.00	6.00	6.00	6.00	5.00	6.00	5.00	5.00	6.00	6.00	2.00	2.00
		5.00	6.00	4.00	6.00	6.00	6.00	2.00	2.00	6.00	1.00	2.00	2.00	4.00	5.00	4.00	1.00	6.00	5.00	1.00	6.00	4.00	6.00	5.00	3.00	3.00	5.00	2.00	2.00	2.00
		4.00	6.00	4.00	6.00	5.00	5.00	2.00	2.00	5.00	6.00	6.00	2.00	6.00	5.00	5.00	1.00	4.00	5.00	7.00	5.00	5.00	5.00	5.00	5.00	4.00	6.00	2.00	2.00	2.00
		5.00	6.00	7.00	6.00	4.00	1.00	1.00	1.00	5.00	1.00	4.00	6.00	4.00	1.00	5.00	1.00	6.00	6.00	4.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		7.00	2.00	7.00	6.00	7.00	1.00	2.00	4.00	7.00	7.00	7.00	6.00	2.00	1.00	1.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		7.00	3.00	7.00	7.00	6.00	5.00	2.00	7.00	7.00	7.00	7.00	7.00	3.00	2.00	2.00	2.00	7.00	6.00	7.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		4.00	6.00	4.00	7.00	6.00	6.00	1.00	1.00	7.00	5.00	5.00	6.00	4.00	2.00	2.00	2.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		4.00	6.00	5.00	5.00	4.00	6.00	3.00	3.00	6.00	6.00	6.00	6.00	2.00	2.00	2.00	1.00	1.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		5.00	6.00	7.00	7.00	6.00	6.00	2.00	2.00	6.00	6.00	6.00	5.00	2.00	2.00	2.00	2.00	6.00	7.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
		5.00	6.00	6.00	4.00	3.00	5.00	4.00	5.00	4.00	5.00	5.00	3.00	7.00	6.00	6.00	4.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
		5.00	5.00	5.00	6.00	4.00	5.00	4.00	2.00	5.00	5.00	6.00	4.00	5.00	2.00	5.00	4.00	6.00	5.00	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		5.00	7.00	6.00	7.00	2.00	6.00	2.00	2.00	6.00	4.00	5.00	3.00	7.00	3.00	7.00	1.00	6.00	5.00	7.00	7.00	6.00	5.00	5.00	6.00	6.00	7.00	5.00	1.00	2.00
		5.00	7.00	6.00	7.00	7.00	2.00	2.00	7.00	5.00	6.00	5.00	7.00	1.00	7.00	1.00	5.00	6.00	6.00	7.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		5.00	6.00	5.00	7.00	6.00	6.00	2.00	4.00	7.00	6.00	6.00	6.00	6.00	5.00	3.00	3.00	1.00	7.00	5.00	7.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		5.00	4.00	4.00	6.00	4.00	4.00	1.00	2.00	4.00	5.00	6.00	6.00	3.00	2.00	2.00	1.00	1.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
		4.00	4.00	6.00	5.00	4.00	5.00	1.00	2.00	6.00	2.00	2.00	5.00	4.00	4.00	4.00	1.00	6.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		7.00	7.00	7.00	7.00	7.00	7.00	1.00	1.00	7.00	4.00	4.00	5.00	6.00	2.00	2.00	2.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		6.00	4.00	6.00	6.00	6.00	6.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00	4.00	2.00	2.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
		5.00	5.00	5.00	5.00	5.00	5.00	2.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
		4.00	5.00	3.00	7.00	2.00	2.00	2.00	2.00	6.00	6.00	6.00	6.00	2.00	4.00	4.00	6.00	2.00	2.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
		4.00	6.00	2.00	6.00	2.00	4.00	4.00	6.00	2.00	4.00	4.00	4.00	4.00	4.00	2.00	2.00	5.00	5.00	6.00	3.00	1.00	1.00	1.00	4.00	4.00	6.00	6.00	6.00	6.00
		5.00	5.00	4.00	7.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	5.00	5.00	4.00	2.00	2.00	6.00	5.00	6.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		2.00	5.00	2.00	4.00	2.00	1.00	7.00	4.00	4.00	4.00	4.00	2.00	7.00	4.00	5.00	1.00	4.00	2.00	6.00	5.00	2.00	1.00	1.00	5.00	7.00	7.00	2.00	2.00	2.00
		2.00	6.00	2.00	7.00	5.00	2.00	4.00	6.00	2.00	6.00	6.00	1.00	5.00	1.00	5.00	5.00	2.00	6.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
		6.00	7.00	7.00	7.00	7.00	1.00	1.00	1.00	7.00	7.00	7.00	7.00	7.00	1.00	4.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		3.00	7.00	3.00	4.00	3.00	4.00	5.00	5.00	3.00	5.00	5.00	5.00	5.00	3.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
		6.00	5.00	7.00	7.00	7.00	2.00	1.00	2.00	6.00	7.00	7.00	7.00	7.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		6.00	4.00	6.00	7.00	6.00	6.00	4.00	1.00	7.00	7.00	5.00	5.00	4.00	3.00	3.00	1.00	7.00	6.00	7.00	7.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
		5.00	4.00	7.00	7.00	5.00	6.00	4.00	3.00	6.00	7.00	7.00	5.00	5.00	3.00	3.00	3.00	6.00	6.00	7.00	6.00	7.00	7.00	7.00	6.00	7.00	5.00	2.00	2.00	2.00

		Project Manager Data																								
		V46	V47	V48	V49	V50	V51	V52	V53	V54	V55	V56A	V56B	V56C	V56D	V56E	V56F	V56G	V11	V12	V13	V14	V15	V16	V17	V18
	0.0	1.00	1.00	0.0		\$5,548,629.00	\$883,829.00	1.00	4.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	0.0	1.00	1.00	0.0	\$26,300,825.00	\$9,640,825.00	90	4.00	6.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	1.00	0.0	0.0	0.0	\$36,000,000.00	\$500,000.00	33	4.00	6.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	0.0	0.0	\$36,500,000.00	\$2,500,000.00	60	5.00	6.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	1.00	1.00	1.00	\$76,143,000.00	\$1,700,000.00	11	2.00	4.00	1.00	1.00	3.00	2.00	2.00	1.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.00	1.00	2.00	2.00	2.00	\$14,087,000.00	\$1,541,482.00	1.00	5.00	4.00	1.00	3.00	2.00	4.00	6.00	7.00	5.00	2.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	2.00	2.00	0.0	1.00	1.00	\$62,625,649.00	\$12,000,000.00	1.00	4.00	5.00	1.00	2.00	6.00	2.00	2.00	4.00	6.00	6.00	6.00	7.00	4.00	2.00	2.00	7.00	4.00	4.00
	2.00	2.00	0.0	1.00	1.00	\$150,000.00	\$150,000.00	1.00	1.00	3.00	5.00	1.00	2.00	5.00	5.00	7.00	4.00	4.00	6.00	3.00	5.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	1.00	1.00	1.00	\$6,100,000.00	\$800,000.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	2.00	2.00	2.00	\$4,100,000.00	\$689,000.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	1.00	1.00	1.00	0.0	\$58,500,000.00	\$8,500,000.00	1.00	5.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	0.0	1.00	1.00	1.00	\$884,000,000.00	\$8,700,000.00	1.15	5.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	0.0	1.00	1.00	1.00	\$87,000,000.00	\$8,000,000.00	1.00	4.00	5.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	1.00	1.00	1.00	1.00	\$1	\$1	1.00	7.00	7.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	1.00	1.00	2.50	\$62,941,000.00	\$1,878,000.00	80	6.00	7.00	1.00	4.00	2.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	2.00	1.00	1.00	2.00	2.00	\$23,600,000.00	\$1,900,000.00	75	5.00	6.00	1.00	3.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	2.00	1.00	1.00	2.00	2.00	\$5,435,000.00	\$250,000.00	1.00	5.00	6.00	2.00	2.00	3.00	3.00	3.00	3.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	1.00	2.00	0.0	1.00	1.00	\$53,109,000.00	\$2,145,000.00	1.00	5.00	4.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	1.00	1.00	1.00	\$26,225,000.00	\$838,000.00	1.00	1.00	2.00	3.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	2.00	1.00	1.00	1.00	1.00	\$212,000,000.00	\$10,000,000.00	1.00	5.00	5.00	1.00	5.00	2.00	4.00	7.00	6.00	6.00	6.00	3.00	7.00	3.00	4.00	7.00	2.00	4.00	1.00
	2.00	2.00	1.00	2.00	2.00	\$189,470.00	\$0.00	1.00	4.00	5.00	1.00	3.00	2.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.00	2.00	2.00	2.00	2.00	\$40,000.00	\$400,000.00	0.00	4.00	6.00	1.00	3.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	0.0	1.00	1.00	1.00	1.00	\$14,247,224.00	\$830,495.00	1.00	8.00	7.00	6.00	2.00	1.00	3.00	3.00	3.00	3.00	3.00	7.00	1.00	7.00	7.00	1.00	7.00	1.00	1.00
	0.0	1.00	1.00	1.00	1.00	\$15,000,000.00	\$906,000.00	1.00	2.00	6.00	6.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	\$4,435,000.00	\$300,000.00	1.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	0.0	0.0	0.0	0.0	0.0	\$4,300,000.00	\$308,411.00	35	3.00	4.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.00	3.00	7.00	7.00	1.00	7.00	1.00	1.00
	1.00	0.00	0.00	0.00	0.00	\$1	\$68,000.00	1.00	4.00	2.00	1.00	3.00	7.00	1.00	1.00	2.00	2.00	7.00	6.00	1.00	7.00	7.00	1.00	7.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	\$2,700,000.00	\$71,000.00	1.00	1.00	1.00	3.00	4.00	2.00	2.00	2.00	2.00	2.00	2.00	6.00	1.00	6.00	6.00	1.00	6.00	1.00	1.00
	1.00	1.00	1.00	1.00	1.00	\$25,500,000.00	\$4,000,000.00	1.00	5.00	3.00	1.00	2.00	2.00	6.00	3.00	4.00	5.00	5.00	6.00	2.00	2.00	6.00	7.00	5.00	6.00	1.00
	2.00	2.00	1.00	2.00	2.00	\$45,000,000.00	\$5,000,000.00	75	4.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	1.00	2.00	2.00	6.00	6.00	2.00	2.00
	2.00	1.00	1.00	1.00	1.00	\$1	\$1	1.00	5.00	1.00	1.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	6.00	6.00	3.00	4.00	4.00	2.00
	2.00	2.00	0.0	1.00	1.00	\$61,572,572.00	\$1,000,000.00	1.00	2.00	3.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	3.00	3.00	2.00	6.00	4.00	2.00	6.00	2.00
	2.00	2.00	0.0	1.00	1.00	\$5,435,000.00	\$200,000.00	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	2.00	2.00	1.00	1.00	1.00	\$93,052,151.00	\$1,996,007.00	1.00	5.00	6.00	1.00	4.00	1.00	1.00	1.00	1.00	1.00	1.00	5.00	2.00	7.00	1.00	4.00	4.00	6.00	1.00
	2.00	2.00	2.00	2.00	2.00	\$1	\$1	1.00	5.00	6.00	1.00	7.00	5.00	5.00	5.00	5.00	5.00	5.00	7.00	1.00	4.00	4.00	4.00	6.00	1.00	1.00

Project Manager Data	VI19	VI10	VI11	VI12	VI13	VI14	VI15	VI16	VI17	VI18	VI19	VI20	VI21	VI22	VI23	VI24	VI25	VI26	VI27	VI28	VI29	VI30	VI31	VI32	VI33	VI34	VI35	VI36	VI37	VI38	VI39	VI40
	5.00	7.00	2.00	4.00	4.00	7.00	5.00	6.00	5.00	1.00	6.00	5.00	7.00	5.00	3.00	3.00	5.00	4.00	4.00	5.00	5.00	7.00	6.00	7.00	7.00	7.00	5.00	7.00	7.00	7.00	7.00	
	6.00	7.00	1.00	6.00	1.00	6.00	6.00	6.00	6.00	4.00	5.00	6.00	6.00	6.00	3.00	2.00	2.00	6.00	6.00	4.00	4.00	7.00	6.00	6.00	6.00	7.00	7.00	6.00	6.00	7.00	7.00	6.00
	7.00	7.00	1.00	7.00	1.00	7.00	6.00	6.00	6.00	6.00	2.00	7.00	5.00	7.00	5.00	1.00	1.00	5.00	4.00	1.00	1.00	1.00	1.00	1.00	7.00	6.00	6.00	1.00	7.00	4.00	4.00	
	5.00	5.00	4.00	2.00	4.00	4.00	3.00	4.00	4.00	5.00	3.00	2.00	4.00	2.00	4.00	4.00	2.00	2.00	4.00	5.00	3.00	4.00	5.00	2.00	1.00	1.00	4.00	1.00	4.00	1.00		
	6.00	5.00	2.00	6.00	2.00	6.00	6.00	5.00	5.00	2.00	6.00	6.00	6.00	6.00	5.00	2.00	2.00	6.00	2.00	6.00	2.00	6.00	4.00	5.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	5.00
	5.00	7.00	5.00	5.00	3.00	5.00	5.00	6.00	5.00	3.00	5.00	5.00	6.00	5.00	6.00	4.00	2.00	3.00	6.00	5.00	4.00	5.00	4.00	5.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	
	6.00	5.00	4.00	7.00	3.00	5.00	6.00	6.00	6.00	3.00	5.00	5.00	6.00	6.00	7.00	3.00	2.00	6.00	3.00	7.00	5.00	2.00	4.00	5.00	5.00	5.00	5.00	7.00	4.00	5.00	7.00	
	3.00	6.00	5.00	4.00	1.00	6.00	5.00	6.00	6.00	6.00	6.00	3.00	4.00	5.00	5.00	3.00	5.00	4.00	2.00	7.00	1.00	6.00	6.00	5.00	6.00	4.00	5.00	5.00	4.00	5.00	5.00	4.00
	VI19	VI10	VI11	VI12	VI13	VI14	VI15	VI16	VI17	VI18	VI19	VI20	VI21	VI22	VI23	VI24	VI25	VI26	VI27	VI28	VI29	VI30	VI31	VI32	VI33	VI34	VI35	VI36	VI37	VI38	VI39	VI40
	7.00	7.00	3.00	4.00	2.00	4.00	4.00	5.00	5.00	2.00	5.00	4.00	6.00	4.00	5.00	2.00	4.00	5.00	1.00	2.00	2.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	
	5.00	6.00	2.00	6.00	2.00	6.00	5.00	5.00	7.00	6.00	3.00	5.00	6.00	5.00	6.00	2.00	1.00	6.00	6.00	7.00	2.00	7.00	7.00	7.00	7.00	5.00	6.00	5.00	7.00	6.00	6.00	
	7.00	7.00	1.00	1.00	6.00	6.00	1.00	6.00	6.00	1.00	2.00	2.00	6.00	2.00	2.00	2.00	2.00	6.00	6.00	5.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.00	4.00	4.00	5.00
	6.00	7.00	1.00	2.00	1.00	7.00	6.00	6.00	6.00	2.00	4.00	6.00	6.00	6.00	1.00	1.00	6.00	2.00	2.00	2.00	3.00	7.00	7.00	7.00	7.00	7.00	7.00	6.00	7.00	7.00	7.00	
	2.00	7.00	4.00	6.00	4.00	1.00	2.00	6.00	4.00	6.00	2.00	4.00	4.00	6.00	3.00	2.00	2.00	4.00	2.00	2.00	3.00	4.00	3.00	2.00	7.00	2.00	2.00	2.00	2.00	2.00	2.00	7.00
	6.00	7.00	2.00	6.00	1.00	6.00	4.00	5.00	5.00	5.00	5.00	5.00	6.00	6.00	2.00	3.00	5.00	4.00	7.00	1.00	4.00	5.00	6.00	7.00	7.00	7.00	7.00	2.00	4.00	4.00	6.00	
	7.00	7.00	1.00	7.00	1.00	7.00	7.00	7.00	7.00	1.00	7.00	6.00	7.00	6.00	1.00	1.00	6.00	7.00	4.00	6.00	4.00	6.00	4.00	6.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	6.00	7.00	6.00	2.00	6.00	2.00	1.00	2.00	2.00	2.00	1.00	1.00	6.00	6.00	1.00	7.00	7.00	3.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
	6.00	7.00	2.00	6.00	2.00	6.00	4.00	5.00	4.00	3.00	5.00	5.00	4.00	5.00	5.00	2.00	2.00	5.00	4.00	5.00	3.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	5.00	5.00	6.00
	5.00	2.00	4.00	2.00	4.00	6.00	4.00	4.00	5.00	2.00	4.00	1.00	5.00	1.00	2.00	2.00	3.00	6.00	6.00	5.00	5.00	6.00	6.00	5.00	5.00	6.00	6.00	5.00	7.00	5.00	7.00	6.00
7.00	7.00	1.00	5.00	2.00	6.00	5.00	6.00	6.00	3.00	6.00	2.00	7.00	3.00	2.00	1.00	3.00	3.00	2.00	2.00	1.00	6.00	1.00	6.00	6.00	6.00	6.00	6.00	6.00	3.00	4.00	4.00	4.00
4.00	7.00	1.00	7.00	1.00	7.00	4.00	7.00	7.00	2.00	6.00	4.00	5.00	7.00	4.00	1.00	4.00	4.00	6.00	7.00	5.00	4.00	7.00	5.00	4.00	7.00	5.00	7.00	7.00	7.00	7.00	7.00	
5.00	6.00	3.00	5.00	5.00	1.00	6.00	5.00	6.00	7.00	2.00	5.00	5.00	6.00	5.00	3.00	1.00	4.00	7.00	7.00	4.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	7.00
3.00	6.00	1.00	1.00	1.00	2.00	4.00	6.00	7.00	7.00	2.00	6.00	6.00	6.00	6.00	2.00	2.00	6.00	5.00	1.00	7.00	2.00	1.00	4.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	7.00
7.00	7.00	1.00	7.00	1.00	7.00	7.00	7.00	7.00	1.00	6.00	7.00	7.00	7.00	7.00	1.00	1.00	7.00	7.00	4.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
3.00	5.00	2.00	6.00	1.00	7.00	6.00	6.00	6.00	3.00	5.00	6.00	5.00	6.00	2.00	2.00	6.00	5.00	3.00	5.00	4.00	5.00	6.00	5.00	6.00	5.00	6.00	5.00	4.00	4.00	3.00	6.00	6.00
7.00	7.00	1.00	7.00	1.00	7.00	7.00	7.00	7.00	1.00	7.00	6.00	7.00	7.00	7.00	1.00	1.00	6.00	7.00	2.00	4.00	3.00	4.00	7.00	4.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
7.00	7.00	1.00	7.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	1.00	1.00	6.00	7.00	2.00	4.00	3.00	4.00	7.00	4.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
7.00	7.00	1.00	7.00	1.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	1.00	1.00	6.00	7.00	2.00	4.00	3.00	4.00	7.00	4.00	6.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
6.00	5.00	1.00	6.00	1.00	7.00	6.00	6.00	6.00	2.00	5.00	6.00	6.00	6.00	2.00	2.00	6.00	4.00	1.00	3.00	6.00	4.00	4.00	2.00	3.00	2.00	4.00	2.00	4.00	2.00	4.00	4.00	4.00
7.00	3.00	1.00	6.00	1.00	7.00	6.00	6.00	6.00	5.00	6.00	6.00	6.00	6.00	2.00	1.00	6.00	2.00	2.00	2.00	2.00	5.00	3.00	5.00	4.00	4.00	3.00	3.00	3.00	3.00	3.00	1.00	
6.00	6.00	2.00	4.00	2.00	6.00	6.00	6.00	6.00	2.00	4.00	6.00	6.00	6.00	2.00	4.00	6.00	5.00	1.00	1.00	4.00	2.00	5.00	2.00	5.00	1.00	4.00	1.00	4.00	1.00	4.00	1.00	1.00
6.00	6.00	2.00	6.00	2.00	5.00	7.00	6.00	6.00	2.00	4.00	4.00	5.00	4.00	2.00	2.00	4.00	4.00	1.00	2.00	5.00	2.00	5.00	2.00	5.00	4.00	6.00	6.00	6.00	6.00	4.00	2.00	5.00
7.00	6.00	5.00	6.00	3.00	6.00	4.00	6.00	6.00	4.00	4.00	5.00	6.00	3.00	3.00	6.00	6.00	5.00	5.00	6.00	6.00	5.00	6.00	6.00	6.00	5.00	6.00	4.00	5.00	6.00	6.00	6.00	
7.00	7.00	1.00	4.00	1.00	1.00	4.00	3.00	4.00	1.00	6.00	4.00	7.00	4.00	1.00	2.00	4.00	5.00	7.00	3.00	4.00	4.00	7.00	6.00	7.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
7.00	7.00	1.00	4.00	1.00	1.00	4.00	3.00	4.00	1.00	6.00	4.00	7.00	4.00	1.00	2.00	4.00	5.00	7.00	3.00	4.00	4.00	7.00	6.00	7.00	6.00	7.00	6.00	6.00	6.00	6.00	6.00	6.00

Project Manager Data	VI111	VI112	VI113	VI114	VI115	VI116	VI117	VI118	VI119	VI120	VI121	VI122	VI123	VI124	VI125	VI126	VI127	VI128	VI129	VI130	VI131	VI132	VI133	VI134	VI135	VI136	VI137	VI138	VI139	VI140	VI141	VI142
	7.00	1.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	6.00	7.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	6.00	1.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	3.00	1.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	5.00	1.00	5.00	■	■	■	6.00	■	■	■	2.00	1.00	2.00	1.00	1.00	1.00	3.00	2.00	2.00	3.00	3.00	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
	6.00	4.00	1.00	■	■	■	3.00	■	■	■	1.00	8.00	6.00	4.00	4.00	7.00	2.00	10.00	9.00	3.00	6.00	5.00	11.00	12.00	3.00	5.00	5.00	5.00	5.00	5.00	5.00	
	4.00	4.00	■	■	■	■	■	■	■	■	5.00	10.00	10.00	10.00	9.00	10.00	8.00	6.00	8.00	6.00	6.00	8.00	12.00	5.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
	5.00	2.00	8.00	1.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	6.00	4.00	■	■	■	■	■	■	■	■	12.00	10.00	9.00	6.00	8.00	8.00	7.00	4.00	2.00	11.00	3.00	5.00	1.00	1.00	12.00	10.00	9.00	■	■	■	■	■
	6.00	4.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	4.00	4.00	■	■	■	■	■	■	■	■	6.00	9.00	10.00	1.00	11.00	7.00	6.00	2.00	12.00	5.00	4.00	3.00	7.00	8.00	9.00	■	■	■	■	■	■	■
	5.00	27.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	5.00	5.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	5.00	1.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	4.00	6.00	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	7.00	1.00	2.00	■	■	■	■	■	■	■	6.00	9.00	7.00	8.00	10.00	10.00	5.00	2.00	12.00	1.00	11.00	3.00	6.00	12.00	11.00	■	■	■	■	■	■	■
	6.00	5.00	2.00	■	■	■	■	■	■	■	4.00	10.00	5.00	3.00	2.00	12.00	6.00	7.00	8.00	9.00	11.00	1.00	9.00	11.00	2.00	■	■	■	■	■	■	■
	6.00	5.00	11.00	12.00	■	8.00	10.00	■	■	10.00	9.00	12.00	4.00	4.00	6.00	3.00	11.00	2.00	6.00	1.00	5.00	7.00	11.00	6.00	10.00	6.00	■	■	■	■	■	■
4.00	4.00	1.00	■	■	11.00	■	■	■	12.00	10.00	9.00	11.00	3.00	5.00	8.00	1.00	4.00	6.00	2.00	4.00	7.00	12.00	11.00	9.00	■	■	■	■	■	■	■	
6.00	1.00	5.00	4.00	■	■	■	■	■	11.00	12.00	1.00	1.00	6.00	5.00	2.00	9.00	3.00	4.00	7.00	8.00	10.00	11.00	12.00	1.00	■	■	■	■	■	■	■	
6.00	1.00	1.00	5.00	■	12.00	13.00	■	■	8.00	11.00	7.00	7.00	11.00	10.00	11.00	11.00	10.00	10.00	8.00	8.00	9.00	7.00	5.00	■	■	■	■	■	■	■	■	
4.00	2.00	5.00	■	■	7.00	■	■	■	7.00	8.00	11.00	9.00	4.00	10.00	5.00	6.00	2.00	3.00	4.00	12.00	1.00	6.00	12.00	9.00	■	■	■	■	■	■	■	
5.00	2.00	3.00	■	■	2.00	■	■	■	7.00	12.00	11.00	4.00	5.00	9.00	6.00	3.00	10.00	8.00	2.00	1.00	10.00	12.00	11.00	■	■	■	■	■	■	■	■	
7.00	7.00	2.00	3.00	■	■	2.00	3.00	■	9.00	5.00	■	■	4.00	1.00	8.00	7.00	10.00	6.00	3.00	2.00	4.00	6.00	3.00	■	■	■	■	■	■	■	■	
6.00	4.00	1.00	■	■	3.00	■	■	■	7.00	10.00	2.00	3.00	9.00	1.00	6.00	5.00	4.00	6.00	7.00	7.00	7.00	10.00	4.00	■	■	■	■	■	■	■	■	
4.00	4.00	2.00	4.00	■	3.00	■	■	■	3.00	4.00	4.00	2.00	4.00	1.00	6.00	5.00	4.00	5.00	4.00	4.00	4.00	4.00	4.00	■	■	■	■	■	■	■	■	
4.00	■	1.00	■	■	1.00	■	■	■	1.00	3.00	2.00	1.00	2.00	2.00	1.00	5.00	10.00	■	1.00	3.00	5.00	4.00	7.00	■	■	■	■	■	■	■	■	
1.00	1.00	2.00	4.00	■	■	4.00	■	■	1.00	2.00	2.00	1.00	3.00	2.00	3.00	3.00	1.00	1.00	3.00	3.00	4.00	■	■	■	■	■	■	■	■	■	■	
2.00	4.00	2.00	4.00	■	■	3.00	■	■	2.00	3.00	3.00	1.00	3.00	2.00	5.00	5.00	4.00	4.00	3.00	1.00	4.00	4.00	3.00	■	■	■	■	■	■	■	■	
1.00	4.00	9.00	10.00	■	3.00	■	■	■	8.00	11.00	8.00	11.00	7.00	5.00	10.00	2.00	11.00	4.00	4.00	4.00	3.00	8.00	10.00	2.00	■	■	■	■	■	■	■	
1.00	4.00	3.00	2.00	■	■	9.00	9.00	■	12.00	11.00	9.00	4.00	2.00	2.00	6.00	5.00	10.00	8.00	3.00	7.00	10.00	9.00	6.00	■	■	■	■	■	■	■	■	
6.00	1.00	6.00	■	■	1.00	■	■	■	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	■	■	■	■	■	■	■	■	
4.00	3.00	7.00	■	■	1.00	■	■	■	12.00	11.00	9.00	8.00	2.00	3.00	7.00	6.00	10.00	1.00	4.00	4.00	5.00	12.00	11.00	9.00	■	■	■	■	■	■	■	
5.00	1.00	13.00	14.00	■	7.00	■	■	■	1.00	1.00	1.00	6.00	3.00	5.00	5.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	■	■	■	■	■	■	■	■	
5.00	1.00	5.00	■	■	7.00	6.00	■	■	6.00	7.00	12.00	8.00	11.00	6.00	10.00	5.00	9.00	10.00	4.00	3.00	1.00	6.00	5.00	10.00	■	■	■	■	■	■	■	
5.00	5.00	5.00	■	■	7.00	6.00	■	■	6.00	7.00	12.00	8.00	11.00	6.00	10.00	5.00	9.00	10.00	4.00	3.00	1.00	6.00	5.00	10.00	■	■	■	■	■	■	■	

Project Manager Data	VII3DO	VII3EO	VII3FO	VII3GO	VII3HO	VII3IO	VII3JO	VII3KO	VII3LO	VAR00004
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	1.00	1.00	1.00	3.00	2.00	2.00	3.00	2.00	3.00	*!
	10.00	3.00	1.00	6.00	4.00	11.00	12.00	8.00	7.00	*!
	10.00	8.00	6.00	10.00	6.00	6.00	6.00	6.00	6.00	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	8.00	7.00	6.00	5.00	2.00	11.00	1.00	4.00	3.00	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	6.00	5.00	1.00	10.00	2.00	11.00	3.00	4.00	12.00	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	8.00	5.00	4.00	*!	2.00	10.00	1.00	7.00	3.00	*!
	8.00	1.00	12.00	4.00	6.00	5.00	3.00	10.00	7.00	*!
	6.00	9.00	4.00	12.00	2.00	7.00	1.00	3.00	8.00	*!
	10.00	3.00	5.00	7.00	1.00	4.00	2.00	6.00	8.00	*!
	6.00	5.00	2.00	9.00	3.00	4.00	7.00	8.00	10.00	*!
	8.00	2.00	1.00	10.00	11.00	12.00	4.00	6.00	3.00	*!
	10.00	3.00	5.00	4.00	7.00	8.00	1.00	2.00	11.00	*!
	7.00	8.00	9.00	6.00	2.00	1.00	5.00	4.00	3.00	*!
	9.00	2.00	1.00	3.00	5.00	*!	6.00	4.00	10.00	*!
	3.00	9.00	1.00	8.00	5.00	4.00	*!	6.00	7.00	*!
	3.00	6.00	3.00	2.00	7.00	6.00	3.00	4.00	1.00	*!
	4.00	5.00	2.00	5.00	1.00	5.00	10.00	*!	5.00	4.00
	*!	*!	*!	*!	*!	*!	*!	*!	*!	*!
	3.00	2.00	4.00	1.00	7.00	6.00	5.00	4.00	2.00	*!
	7.00	6.00	1.00	5.00	2.00	11.00	3.00	4.00	12.00	*!
	3.00	2.00	1.00	8.00	5.00	10.00	7.00	4.00	12.00	*!
	2.00	11.00	2.00	1.00	2.00	1.00	2.00	1.00	2.00	*!
	5.00	2.00	1.00	8.00	3.00	10.00	4.00	6.00	7.00	*!
	3.00	1.00	1.00	3.00	3.00	3.00	3.00	2.00	1.00	*!
	7.00	4.00	2.00	1.00	8.00	11.00	9.00	12.00	3.00	*!
	7.00	4.00	2.00	1.00	8.00	11.00	9.00	12.00	3.00	*!

References

- Albright, S.C., Winston, W., and Zappe, C.J. 2003. *Data Analysis & Decision Making with Microsoft Excel*. Brooks/Cole, Pacific Grove, CA.
- Anderson, S., Patil, S. and Gibson, G.E. 2000. *Developing Optimal Owner-Contractor Work Structures-Case Studies*. Center for Construction Industry Studies, The University of Texas at Austin, Report No. 12.
- Anderson, S., Patil, S. and Gibson, G.E. 2000. *Developing Optimal Owner-Contractor Work Structures (OCWS)-Validation of the OCWS Process*. Center for Construction Industry Studies, The University of Texas at Austin, Report No 15.
- Araujo, L., Dubois, A. and Gadde, L.E. 1999. *Managing Interfaces with Suppliers*. *Industrial Marketing Management*, 28 (5), Pp. 497-506.
- Baumard, P. 1996. *Organizations in the Fog: An Investigation into the Dynamics of Knowledge*. In *Organizational Learning and Competitive Advantage* edited by Moingeon, B. and Edmondson, A. (1996). Saga Publications, London.
- Davis-Blake, A., Dickson, K.E., Broschak, J.P., Gibson, G.E., Rodriguez, F.J. and Graham, T.A. 1999. *Owner/Contractor Organizational Changes, Phase II Report*. Center for Construction Industry Studies, The University of Texas at Austin, Report No. 2.
- Davis-Blake, A., Gibson, G.E., Dickerson, K., and Mentel, B. 2001. *Workforce Demographics Among Engineering Professionals, A Crisis Ahead?* Center for Construction Industry Studies, The University of Texas at Austin, Report No. 21.
- Deering, A. and Murphy, A. 1998, *The Difference Engine: Achieving Powerful and Sustainable Partnering*. Gower Publishing Limited, Hampshire, England.
- Edwards, G. and Snyder, D.P. 1999. *Information Innovation: Where Do We Go From Here?* *The Journal for Quality and Participation*, 22 (2: March/April), Pp. 6-12.

- Engineering News Record. 1999. The Shape of Things to Come. 242 (No. 20: May 24), Pp. 43-56.
- Federal Facilities Council. (FFC). 1998. Government/Industry Forum on Capital and Core Competencies. Summary Report, Federal Facilities Council Report No.136, National Academy Press, Washington, D.C.
- Gibson, G.E., Davis-Blake, A., Broschak, J.P., and Rodriguez, F.J. 1998. Owner/Contractor Organizational Changes Phase I Report. Center for Construction Industry Studies, The University of Texas at Austin, Report No. 1.
- Gibson, G.E., and Ryan, D. 2000. Emerging Trends in Owner/Contractor Organizational Changes from The Contractor's Perspective. Center for Construction Industry Studies, The University of Texas at Austin, Report No. 11.
- Gibson, G.E., Jantz, G., and Graham, P. 2001. Owner Outsourcing Trends and Their Affects on Project Practices and Performance. Center for Construction Industry Studies, The University of Texas at Austin, Report No. 19.
- Godfrey, K.A, Jr. 1996. Partnering In Design and Construction. McGraw-Hill, New York, NY.
- Graham, T. A. 1999. Effects of Owner Outsourcing on Construction Project Performance. Thesis, The University of Texas at Austin, TX.
- Hakansson, H., Havila, V., and Pedersen, A.C. 1999. Learning in Networks. Industrial Marketing Management, 28 (5), Pp. 443-452.
- Hult, G. T .M. 1998. Managing the International Strategic Sourcing Process as a Market-Driven Organizational Learning System. Decision Sciences, 29 (1), Pp. 193. In Search of Partnering Excellence. (1991). CII Publication 17-1. Bureau of Engineering Research, The University of Texas at Austin, TX.
- Larson, E. 1995. Project Partnering: Results of Study of 280 Construction Projects. Journal of Management in Engineering, II (2), Pp. 30-35.

- Levy, B. 1996. Outsourcing Strategy and a Learning Dilemma. *Production and Inventory Management Journal*, 37 (4), Pp. 50-54.
- McKinley, W., Sanchez, C.M., and Schick, A. 1997. Organizational Downsizing: Constraining, Cloning, Learning. *IEEE Engineering Management Review*, 25 (1), Pp. 16-23.
- Quinn, J.B, and Hilmer, F.G. 1994. Strategic Outsourcing. *Sloan Management Review* (Summer 1994): Pp. 43-55.
- Ryan-Rose, D. J. 2002. Emerging Trends in Owner/Contractor Organizational Changes From The Contractor Perspective. Unpublished manuscript, The University of Texas at Austin.
- Stata, R. 1989. Organizational Learning-The Key to Management Innovation. *Sloan Management Review* (Spring 1989): Pp. 63-69.
- Turabian, K. L. 1987. A Manual for Writers of Term Papers, Theses, and Dissertations. 5th ed. Chicago: The University of Chicago Press.
- Underhill, T., 1996. Strategic Alliances: Managing the Supply Chain. PennWell Books, Tulsa, Oklahoma.
- Webb, E.J., Campbell, D.T., Schwartz, R.D., Sechrest, L. and Grove, J.B. 1981. Nonreactive Measures in the Social Sciences- 2nd Edition. Houghton Mifflin Co., Boston, MA.

Vita

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